

REPORT DOCUMENTATION PAGE				Form Approved OMB NO. 0704-0188	
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1. REPORT DATE (DD-MM-YYYY) 03-09-2013		2. REPORT TYPE Final Report		3. DATES COVERED (From - To) 1-Jun-2010 - 31-May-2013	
4. TITLE AND SUBTITLE University of Kansas Research and Educational Support for U. S. Army Programs and Initiatives at Fort Leavenworth, Kansas				5a. CONTRACT NUMBER W911NF-10-1-0232	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER 611104	
6. AUTHORS Denning, G. Michael; Steele, William B., Johnson, William C.; Chauvin, Keith W.; Omelicheva, Mariya Y.; Dobson, Jerome E.; Herlihy, Peter H.; Mandel, Rolf D.; Hoopes, John W.; Macpherson, Gwen L.; Haufler,				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAMES AND ADDRESSES University of Kansas Center for Research, Inc. 2385 Irving Hill Road  Lawrence, KS 66045 -7568				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Office P.O. Box 12211 Research Triangle Park, NC 27709-2211				10. SPONSOR/MONITOR'S ACRONYM(S) ARO	
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13. SUPPLEMENTARY NOTES The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other documentation.					
14. ABSTRACT From 8/2012 to 5/31/2013, the University of Kansas delivered advanced educational programs and research initiatives to the DOD. Award-sponsored research areas included testing a participatory research mapping tool to improve U.S. soldier human geography worldwide; modeling cultural landscapes and water resources in Afghanistan; and enhancing access to free skills-building information on community development for the Middle East and North African (MENA) Region through a community development toolbox. In addition to scientific					
15. SUBJECT TERMS Water, Afghanistan, Karez, education, Kansas, Bowman Expeditions, supply chain management, community tool box, logistics, fellowships, global, international, master's degrees, foreign, military, executive, leadership, command					
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a. REPORT UU	b. ABSTRACT UU	c. THIS PAGE UU			19b. TELEPHONE NUMBER 785-864-1684

## Report Title

University of Kansas Research and Educational Support for U. S. Army Programs and Initiatives at Fort Leavenworth, Kansas

### ABSTRACT

From 8/2012 to 5/31/2013, the University of Kansas delivered advanced educational programs and research initiatives to the DOD. Award-sponsored research areas included testing a participatory research mapping tool to improve U.S. soldier human geography worldwide; modeling cultural landscapes and water resources in Afghanistan; and enhancing access to free skills-building information on community development for the Middle East and North African (MENA) Region through a community development toolbox. In addition to scientific research, KU delivered education programs in support of DOD: (1) an MA program focusing on interagency collaboration for US SOF officers who attend the Army's Command and General Staff College; (2) a graduate business program that educates U.S. logisticians on understanding the military supply chain through a broader, civilian economy focus; and (3) a pre-command leadership development program that teaches U.S. Army officers an understanding of strategy, external environment, and strategic thinking in the U.S. corporate world. In addition to advanced degree programs, a fellowship supported the Foreign Military Studies Office at Fort Leavenworth in academic research which would otherwise go unstudied. Because of these educational programs and research initiatives, KU has provided soldiers and the Army with advanced academic preparedness for, and new understandings of, future operating environments.

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**Enter List of papers submitted or published that acknowledge ARO support from the start of the project to the date of this printing. List the papers, including journal references, in the following categories:**

**(a) Papers published in peer-reviewed journals (N/A for none)**

Received

Paper

**TOTAL:**

**Number of Papers published in peer-reviewed journals:**

---

**(b) Papers published in non-peer-reviewed journals (N/A for none)**

Received

Paper

**TOTAL:**

**Number of Papers published in non peer-reviewed journals:**

---

**(c) Presentations**

1. Boss, Jeffrey. "The Future of the Frontier Crimes Regulation and Implications for Security at the Afghan-Pakistan Border."
2. Karnysheva, Margarita. "The Buriats across the Borders: Smuggling and Insurgency in Transbaikalia (1921-1929)."
3. Du, Ruoxi. "Chinese Perceptions toward the post-2014 Afghanistan."
4. Du, Ruoxi (with Dr. Mariya Y. Omelicheva): Small States in Great Power Politics: the Impact of Kazakhstan's Multi-Vectorism on Sino-Russian Relations."
5. Pickett, Nathaniel. "Territorial Cleansing: The Geopolitical Where of Genocide and Mass Violence."
6. Agranoff, Robert; McGuire, Michael; and Chris Silvia. "Putting the "Public" Back into Collaborative Public Management."
7. Moldogaziev, Tima and Silvia, Chris. "Leading to Motivate: The Effect of Leadership Styles on Organizational Motivation and Commitment."
8. Silvia, Chris. "The Impact of Simulations on Higher Level Learning."
9. Silvia, Chris and Rachel Krause. "Assessing the Impact of Policy Interventions on the Adoption of Plug-In Electric Vehicles: An Agent-Based Model."
10. Getha-Taylor, Heather, John Nalbandian, and Chris Silvia. "MPA Competency Model Design and Assessment: Findings and Future Directions."
11. Egitto, A.C. CHAMP Roundtable for Original Research.
12. Egitto, A.C. and A. Weiser, "Archaeology of Afghanistan and LiDAR in the Detection of Archaeological Features."
13. Hoopes, J., R. Mandel, P. Stinson, and A. C. Egitto. "Karez Case Studies in Southern Afghanistan."
14. Hoopes, J. "Water, Archaeology, Landscape Culture."
15. Stinson, P. "Karez Systems and Settlement Morphology in Southern Afghanistan."
16. Stinson, P. Moderator. CHAMP Roundtable for Original Research.
17. Mandel, R.D., P.T. Stinson, J.W. Hoopes, and A.C. Egitto, "Modeling Cultural Landscapes and Water Resources: A Case Study in Afghanistan."
18. Stinson, P. "Karez Case Studies in Southern Afghanistan."
19. Stinson, P. "Joining Geographic Information Systems (GIS) and Humanistic Research: The Traditional Karez Water System in Southern Afghanistan."
20. Egitto, Antoinette C. 2013. "Remote Sensing Assessment of Karez Irrigation Systems and Archaeological Resources in Maywand District."
21. Wieser, A. Research visit to the Center for Afghanistan Studies, Arthur Paul Afghanistan Collection in the Criss Library, University of Nebraska at Omaha, May 20-24, 2013.
22. Tappan, Bryce 2013. "Mapping of Four Indigenous Tawahka Communities in Honduras."
23. Dobson, Jerome E. 2012. "Human Geography is More Than Human Terrain."
24. Kelly, John H. 2012. "Indirect Expressions of Indigenous Territoriality in Mexico and Honduras – Are They Self-Determination?"
25. Herlihy, Peter H. and Kelly, John H. 2011. "GIS in Indigenous Communities isn't Participatory GIS: Examples in Honduras and Mexico."
26. Kelly, John H. 2011. "The First Rule of Being an Ally: Tom McMaster and Oaxaca's Maestros as Self-appointed Spokespersons for the Subaltern."
27. Herlihy, Peter H. 2010. "Los Territorios Indígenas y el fin de la "propiedad social" en México."
28. Dobson, Jerome E. 2010. "Mastering the Human Domain: Socio-Cultural Intelligence and Analysis."
29. Brown, Marie Grace. "Dressing Up: Girls and the Politics of Fashion in Northern Sudan, 1900-1950."
30. Brown, Marie Grace. "Fashioning their Place: Dress and Global Imagination in Sudan."
31. Macpherson, Gwen L. "The Architecture and Vulnerability of Water-Supply in Water-Scarce Regions."
32. Johnson, W.C., Macpherson, G.L., Dobbs, K.E., Mein, A. "Ancient karez groundwater acquisition systems in the context of the southern Afghanistan landscape."
33. Macpherson, G.L., Johnson, W.C., Whisner, C.R., Dobbs, K.E., Egbert, S.L. "Karez systems of southern Afghanistan—Adaptation to Environmental Change."
34. Johnson, W.C., Dobbs, K.E., Egbert, S.L., Macpherson, G.L., "Imaging the Karez Irrigation Systems of Afghanistan."
35. Macpherson, G.L., Whisner, C., Johnson, W.C. "Karez response to past, present, and future climate: the ancient water-supply system is a crucial modern water source in Afghanistan."
36. Johnson, W.C., Macpherson, G.L., Dobbs, K.E., Mein, A. "Landscapes and Karez Irrigation Systems in the Kandahar Region of Southern Afghanistan."
37. Johnson, W.C. "Karez irrigation in Afghanistan—a remote sensing

approach.”

38. Johnson, W.C., Dobbs, K.E., Macpherson, G.L., Egbert, S.L. “Imaging Karez Systems of the southern Afghanistan Landscape.”

39. Johnson, W.C. “Modeling Landscapes and Geomorphic Processes to Assess Sensitivity to Environmental Change.”

40. Johnson, W. C., Z. Price, A. R. Mein, K. E. Dobbs, G. L. Macpherson.

“Landscape setting of ancient karez irrigation systems in southern Afghanistan, A remote sensing approach.”

41. Whisner, Carla, and G. L. Macpherson, 2010. “Groundwater flow through a horizontal drain in an alluvial fan aquifer, Kandahar, Afghanistan.”

42. Macpherson, G.L., “Modeling Cultural Landscapes and Water Resources: Karez Case Study.”

43. Macpherson, G.L. and Johnson, W.C.: L. Rush, Fort Drum, NY, 2-3 September 2010.

44. Mandel, R., Hoopes, J., Stinson, P.: L. Rush, Fort Drum, NY, 26-27 August 2010.

45. Holt, Christina; Fawcett, Stephen. “Some Stimulating Experiences with Online Training on Community Health and Development.”

46. Holt, Christina; Fawcett, Stephen. “Supporting Transformative Community Change Efforts Using Online Technology.”

47. Holt, Christina; Fawcett, Stephen. “Community Tool Box: Web-Based Supports for Community Improvement.”

48. Holt, Christina; Fawcett, Stephen. “Web-Based Supports for Implementing Healthy People 2020.”

49. Holt, Christina; Fawcett, Stephen. “Online Resources for Civic Engagement: the Community Tool Box.”

50. Holt, Christina; Fawcett, Stephen. “Community Change Academy.”

51. Holt, C., Fawcett, S., and Schultz, J. (2010, February). “Supporting Development and Stability Operations Using KU’s Community Tool Box.”

52. Holt, C., Fawcett, S., and Schultz, J. (2010, December). “Supporting Development and Stability Operations Using KU’s Community Tool Box – An Update.”

53. Fawcett, S., and Holt, C. (2010, November). “Using the Community Tool Box to Support Community Health Assessments.”

54. Holt, C. (2011, April). “Online Resources for Public Administrators: The Community Tool Box.”

**Number of Presentations:** 54.00

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### Non Peer-Reviewed Conference Proceeding publications (other than abstracts):

<u>Received</u>	<u>Paper</u>
08/16/2013 15.00	Johnson, W. C., Dobbs, K. E. , Macpherson, G.L. , Egbert, S.L.. Karez systems and landscape modeling in southern Afghanistan, 9th International Conference of Military Geoscience. 2011/06/20 01:00:00, . : ,
08/16/2013 16.00	Macpherson, G.L. , Dobbs, K.E. , Mein, Alicia, Johnson, W.C.. Ancient kariz groundwater acquisition systems in the context of the southern Afghanistan landscape, GSA Abstracts with Programs, Geological Society of America Annual Meeting. 2011/10/09 01:00:00, . : ,
08/16/2013 19.00	Kastens, J. H., , Lee, E. , Dobbs, K. E., Macpherson, G. L, Johnson, W. C.,. Flood Modeling in a region of political instability—a case study of Afghanistan, 10th International Conference on Military Geosciences: Rebellions and Military Reactions (ICMG). 2013/06/17 01:00:00, . : ,
08/27/2013 43.00	Herlihy, Peter H.. Participatory Mapping and the AGS Bowman Prototype, 1st World Human Geography Conference: Communities and Ethics of the American Geographical Society. 2011/09/16 01:00:00, . : ,
<b>TOTAL:</b>	<b>4</b>



**Number of Non Peer-Reviewed Conference Proceeding publications (other than abstracts):**

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**Peer-Reviewed Conference Proceeding publications (other than abstracts):**

<u>Received</u>	<u>Paper</u>
08/16/2013	20.00 Whisner, Carla, Macpherson, G.L.. Computer simulations using visual modflow showing the effects of climate change on karezes near Khandahar, Afghanistan, SACNAS National Conference: "Advancing Hispanics/Chicanos & Native Americans in Science". 2010/09/30 01:00:00, . : ,
08/16/2013	17.00 Macpherson, G. L., Whisner, Carla , Johnson, W. C.. Karez responses to past, present and future climate: The ancient water-supply system is a crucial modern water source, 9th International Conference of Military Geoscience. 2011/06/20 01:00:00, . : ,
08/20/2013	25.00 Macpherson, G. L. , Stotler, R. L., Johnson, W. C.. How Vulnerable is Water Supply in Water-Scarce Regions in Times of Military Conflict?Sahel, Sahara, Somalia, Syria and Yemen, Tenth International Conference on MilitaryGeosciences. 2013/06/17 01:00:00, . : ,
08/23/2013	33.00 Tappan, Taylor. The Role of Schools in Shaping Miskitu Settlement Landscapes and Territoriality in the Honduran Mosquitia, Association of American Geographers. 2013/04/09 01:00:00, . : ,
08/27/2013	34.00 Herlihy, Peter H.. Titling Horizontal Spaces of Indigenous Communities in the Rainforests of Central America and Mexico, Simposio: Los Muchos Contextos del Espacio, Universidad de Costa Rica. 2011/03/21 01:00:00, . : ,
08/27/2013	44.00 Kelly, John H.. It's Never Too Late: Reviving and Extending Participatory Map Data for Indigenous Reserve Management and Land Tenure in Honduran Mosquitia, Annual Meeting of the Association of American Geographers. 2011/03/01 01:00:00, . : ,
<b>TOTAL:</b>	<b>6</b>

**Number of Peer-Reviewed Conference Proceeding publications (other than abstracts):**

---

**(d) Manuscripts**

<u>Received</u>	<u>Paper</u>
08/06/2013	10.00 C. Silvia. Collaborative Governance Concepts for Successful Network Leadership, State and Local Government Review (03 2011)
08/09/2013	11.00 Derek A. Smith, Peter H. Herlihy, Aida Ramos Viera, John H. Kelly, Andrew M. Hilburn, Miguel Aguilar Robledo, Jerome E. Dobson. Using Participatory Research Mapping and GIS to Explore Local Geographic Knowledge of Indigenous Landscapes in Mexico, FOCUS on Geography (12 2012)
08/18/2013	21.00 Stocker, Jeffrey. The production, spread, and use of artisan firearms in Sub-Saharan Africa, (06 2010)
08/19/2013	22.00 Holt, Christina M., Fawcett, Stephen B., Schultz, Jerry A. , Berkowitz, Bill, Wolff, Thomas J., Francisco, Vincent T.. Building community practice competencies globally through the Community Tool Box, (05 2013)
08/19/2013	24.00 Silvia, Chris. The impact of simulations on higher-level learning, (05 2011)
08/19/2013	23.00 Getha-Taylor, Heather , Hummert, Raymond , Nalbandian, John , Silvia, Chris. Competency Model Design and Assessment: Findings and Future Directions, (02 2012)
08/23/2013	28.00 Kelly, John H.. Land ownership and the production of water, Reflexiones (04 2011)
08/23/2013	31.00 Dobson, Jerome E., Egbert, Steve L., Dunbar, M.D. , Kostelnick, J.C.. Geographers tackle landmines, Focus on Geography (11 2009)
08/23/2013	32.00 Kelly, John H. , Herlihy, Peter H., Smith, Derek A., Viera, Aida Ramos, Hilburn, Andrew M., Hernández Cendejas, Gerardo A.. Indigenous Territoriality at the End of the Social Property Era in Mexico, Journal of Latin American Geography (12 2009)
08/28/2013	45.00 Dobson, Jerome E.. The Why, What, and Where of Bowman Expeditions, FOCUS on Geography (01 2011)
09/06/2012	4.00 Ruoxi Du . The Patriotic Education Campaign in China and the Rise of Chinese Nationalism: A Comparison between Official Doctrines and Public Opinion, FMSO Monograph (02 2012)
09/06/2012	5.00 Ruoxi Du . Central Asian Energy: A Point of Contention or Collaboration in Russia-China Relations, FMSO Monograph (07 2011)
09/06/2012	1.00 Christina M. Holt, Stephen B. Fawcett, Jerry A. Schultz, Jami A. Jones, Bill Berkowitz, Thomas J. Wolff, Vincent T. Francisco, Philip W. Rabinowitz. Disseminating Online Tools for Building Capacity among Community Practitioners, Journal of Prevention and Intervention in the Community (06 2012)
09/07/2012	6.00 Nathaniel Pickett. Homeland vs. Our Land: Conflicting Identities in Crimea, FMSO Monograph (05 2011)
09/10/2012	9.00 Derek Smith, , Peter Herlihy, , Aida Ramos Viera, John Kelly, Andrew Hilburn, Miguel Aguilar Robledo, Jerome Dobson. Using Participatory Research Mapping and GIS to Understand Local Geographic Knowledge of Indigenous Landscapes in Mexico, FOCUS on Geography (03 2012)

**TOTAL: 15**

Number of Manuscripts:

Books	
Received	Paper
TOTAL:	

Patents Submitted

Patents Awarded

Awards

- 1)Andrew M. Hilburn, 2011 US DOE Fulbright-Hays Grant to Mexico.
- 2)Peter H. Herlihy awarded the University of Kansas George & Eleanor Woodyard International Educator Award, 2010.
- 3)Jerome Dobson recognized as Fellow of University Consortium for Geographic Information Science, elected 2011.
- 4)Jerome Dobson served as Jefferson Science Fellow, National Academies and U. S. Department of State, 2010- 2011.
- 5)Gwendolyn L. Macpherson, Certificate of Appreciation, International Association of Geochemistry, 28 June 2013.
- 6)Nathanial Pickett, MA Porfolio Defense (with honors), 2012.
- 7)Ruoxi Du, MA Porfolio Defense (with honors), 2012.
- 8)The John Kalafat in Applied Community Psychology, 2013 Community Program Award, Presented to the Community Tool Box Team, Society for Community Research and Action, Division 27, American Psychological Association, June 2013.
- 9)Medical Reserve Corps 2013 Outstanding National Partnership Organization Award, Presented to the Community Tool Box Team, by the Division of the Civilian Volunteer Medical Reserve Corps, Office of the Surgeon General, June 2013.
- 10)Don Klein Publication Award to Advance Community Psychology Practice, 2013 Award, Presented to the Community Tool Box Team, Society for Community Research and Action, Division 27, American Psychological Association, June 2013.
- 11)John H.Kelly, Ph.D. Dissertation with honors, University of Kansas, 2013.

Graduate Students

<u>NAME</u>	<u>PERCENT SUPPORTED</u>	Discipline
Samz-Pustol, Andrea	0.24	
Naglak, Matt	0.67	
Murphy, Holly	0.09	
Leon, Anne	0.46	
Nieldzilski, Benjamin	0.07	
Price, R. Zane	0.43	
Liu, Huan	0.92	
Egitto, Anne	0.78	
King-Savic, Sandra	1.00	
Whisner, Carla	0.25	
Kelly, John	0.60	
Hilburn, Andrew	0.50	
Kanj, Mayada	0.00	
Du, Ruoxi	1.00	
Pickett, Nathaniel	0.50	
Wieser, Anna	0.81	
Callen, Patrick	1.00	
Masten, Randy	1.00	
Boss, Jeffery	1.00	
Ataya, Alexandra	0.00	
Stocker, Jeffrey	1.00	
Ramos, Aida	0.00	
Karnysheva, Margarita	1.00	
Martin, Molly	0.50	
Funcheon, Gloria	1.00	
Lee, Eunmok	0.14	
<b>FTE Equivalent:</b>	<b>14.96</b>	
<b>Total Number:</b>	<b>26</b>	

#### Names of Post Doctorates

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
<b>FTE Equivalent:</b>	
<b>Total Number:</b>	

#### Names of Faculty Supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>	National Academy Member
Afifi, Rima	0.03	No
Dobson, Jerome	0.23	
Herlihy, Peter	0.15	
Stinson, Philip T.	0.27	
Johnson, William C.	0.09	
Macpherson, Gwen L.	0.09	
Fawcett, Steve	0.01	
Schultz, Jerry	0.01	
Jindra, Tom	0.11	
Chauvin, Keith	0.03	
Lewis, Adrian R.	0.01	
Marashi, Afshin	1.00	
Denning, G. Michael	0.00	
Mandel, Rolfe	0.09	
Hoopes, John	0.09	
Arikan, Mazhar	1.00	
Haufler, Marsha	0.00	
Silvia, Chris	0.95	
Omelicheva, Mariya	0.00	
Freix, Greg	0.13	
<b>FTE Equivalent:</b>	<b>4.29</b>	
<b>Total Number:</b>	<b>20</b>	

#### Names of Under Graduate students supported

<u>NAME</u>	<u>PERCENT SUPPORTED</u>	Discipline
Mein, Alicia	0.00	Geography
Hubbell, Natalie	0.10	Engineering
Tappan, Bryce	0.50	Geography
<b>FTE Equivalent:</b>	<b>0.60</b>	
<b>Total Number:</b>	<b>3</b>	

#### Student Metrics

This section only applies to graduating undergraduates supported by this agreement in this reporting period

The number of undergraduates funded by this agreement who graduated during this period: .....	2.00
The number of undergraduates funded by this agreement who graduated during this period with a degree in science, mathematics, engineering, or technology fields:.....	2.00
The number of undergraduates funded by your agreement who graduated during this period and will continue to pursue a graduate or Ph.D. degree in science, mathematics, engineering, or technology fields:.....	2.00
Number of graduating undergraduates who achieved a 3.5 GPA to 4.0 (4.0 max scale):.....	1.00
Number of graduating undergraduates funded by a DoD funded Center of Excellence grant for Education, Research and Engineering:.....	0.00
The number of undergraduates funded by your agreement who graduated during this period and intend to work for the Department of Defense .....	0.00
The number of undergraduates funded by your agreement who graduated during this period and will receive scholarships or fellowships for further studies in science, mathematics, engineering or technology fields: .....	0.00

#### Names of Personnel receiving masters degrees

NAME

Augustine, Albert  
Bryant, Danford  
Button, Cody  
Kautzman, Janette  
Witherell, Chad  
Hudson, David  
Kreitz, Eric  
Stone, Michael  
Cooney, Edward  
Dimarzio, Jeffrey  
Matthews, Jarret  
Mills, Travis  
Mince, Michael  
Reber, Michael  
Menendez, Jose E.R.  
Swindler, Nathan  
Pearce, Mike  
Riggins, Jack  
Wright, Mat  
Asban, Elena  
Anderson, Christian  
Anderson, Eric  
Austin, Marc  
Baker, Kerry  
Cartwright, Misca  
Chapman, Christopher  
Evelyn, Scott  
Gallagher, James  
Garrett, Annette  
Gomez, Matthew  
Hanifin, Jason  
Haynes, Malcolm  
James, Anglea  
James, Travis  
Johnson, Nicholas  
Johnson, Stephen  
Kienzle, Gregory  
Knorr, Matthew  
Lang, Anthony  
Langkamp, Keirya  
Martinez, Eloy  
Mbonu, Ambrose  
McClelland, Patrick  
Miller, Zachary  
Nangle, Chad  
Ortiz, Dennis  
Rodriguez, Frederic  
Roney, Christine  
Speaks, Roy  
Straus, Joel  
Work, Jason  
Watson, Jason  
Cook, Beth  
Cullen, John  
Everett, James  
Fisher, James  
Gambrell, Robert  
Garvin, Christopher

Geishaker, James  
Hoffman, Derek  
Lewis, Christina  
Lopez, Ernesto  
Lovell, Matthew  
McGovern, Justin  
McLean, Christopher  
McLendon, Scott  
Miller, Samuel  
Mize, Brian  
Monney, Gamble  
Mullerheim, Michael  
Nix, George  
Nottberg, Andrew  
Park, Chi  
Quail, Jeffrey  
Redfern, Justin  
Roberts, Chad  
Salvadore, Rizaldo  
Savoie, Scott  
Squyres, Daniel  
Sweeney, Matthew  
Takas, Christine  
Tarlton, Delarius  
Weestrand, Jeremy  
Du, Ruoxi  
King-Savic, Sandra  
Naglak, Matt  
Pickett, Nathaniel  
Martin, Molly  
Boss, Jeffrey  
Stocker, Jeffrey  
Murphy, Holly  
**Total Number:**

91

#### Names of personnel receiving PhDs

NAME

Price, R. Zane  
Egitto, Anne C.  
Karnysheva, Margarita V.

**Total Number:**

3

#### Names of other research staff

<u>NAME</u>	<u>PERCENT SUPPORTED</u>
Dobbs, Kevin	0.10
Holt, Christina	0.01
Kampfer, Michelle	0.02
Bibi, Ghanen	0.25
Issa, Ghassan	0.10
Daher, Mohamed	0.10
Wehbe, Claude	0.50
Saheli, Rania	0.50
Ataya, Alexandra	0.60
Irving, Jessica	0.50
Lemmons, Monica	0.00
Kanj, Mayada	0.00
<b>FTE Equivalent:</b>	<b>2.68</b>
<b>Total Number:</b>	<b>12</b>

**Sub Contractors (DD882)**

**Inventions (DD882)**

**Scientific Progress**



See attachment, "ARO-KU\_Thrust1\_FINAL\_RPT.pdf"

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## **Technology Transfer**

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## I. Modeling Cultural Landscapes and Water Resources: A Case Study in Afghanistan.

Research activities in archaeology, anthropology, and geoarchaeology during Years One, Two and Three of ARO-Thrust One (walc.ku.edu) involved: 1) creating a bibliographic database relevant to karez studies, 2) documenting the significance of karez in traditional water management in Afghanistan, 3) placing karez within archaeological, historical, and cultural contexts, and 4) creating an inventory of karez and related features (modern settlements, archaeological sites, and other cultural remains) in Kandahar and Helmand Provinces. Specifically, the team's comprehensive project bibliography expanded to over 1,400 entries. Our team gained access to LiDAR and orthorectified aerial photography for

Afghanistan from the U.S. Army Corps of Engineers Geospatial Center in January 2012. Using this high-resolution remote sensing data in combination with medium resolution Google Earth imagery, other remote sensing sources, and GIS, our large-scale survey documented over 5,500 karezes and traces of karezes in southern Afghanistan. Development of methods for assessing whether or not a karez is active offers improved documentation over previous studies whose quality has been compromised by the repetition of outdated data originating as far back as 1967-8. Our results provide updated data, representing the most accurate GIS-based assessment of karez usage in this region of south-central Asia to date. In addition, a close analysis of Maywand District in Kandahar identified 107 features of interest in addition to karezes. For this case study, our team created a gazetteer that identified potential archaeological sites undocumented in the existing literature. Also, two interrelated aspects of Afghanistan's traditional water culture were assessed: (1) the forms of functioning karez systems, with considerations such as their different types of designs and configurations; and (2) the relationships of karez systems to the sites they serve, with focus on settlement morphology, organization, and social structure. Progress on this objective involved analysis of the karez systems and related cultural features of many sites within a case-study zone in southern Afghanistan. Activities included mapping and charting of karez systems, statistical data collection for a select group of karez systems and sites, establishment of a working "cultural model" for a typical karez system and a typical community, and identification of evidence for karez system modification, relocation and abandonment.

In summary, the three years of ARO-Thrust One research activities involved resource acquisition, data collection, and data analysis. The results will assist ARO and DoD in assessing levels of environmental and water insecurity in Afghanistan. In particular, the project's distinctive methodologies of combining various forms of remote sensing data with GIS demonstrate considerable promise for application in other international arenas that share southern Afghanistan's semi-arid landscapes and rich cultural heritage.

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# 1. Large-Scale Mapping of the Karez Water Supply Systems of Southern Afghanistan

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*Phil Stinson, Ph.D., Investigator*

Department of Classics, University of Kansas

Graduate Student Research Assistants (GRA's): Matt Naglak, M.A., and Andrea Samz-Pustol

Over the course of three years of funding, Stinson and a small team of graduate students from the Department of Classics researched and mapped the traditional water systems of southern Afghanistan known as *karez* (in general, see Balland 1992; de Planhol 2011a-e). The methods used to carry out the research involved remotely gathered data and were GIS-based (Google Earth and ESRI ArcGIS). After one year of preliminary investigations and two years of intensive mapping, the project's primary achievement was the creation of a large-scale map showing all active and inactive karezes in southern Afghanistan (Fig. 1.1).

## Year 1 Results

Research activities during Year 1 of the project assessed the cultural characteristics of karez water systems and communities served by them within a case-study zone west of Kandahar. The active karez systems were identified through visual analysis of the landscape as represented in Google Earth. In addition, a preliminary 'cultural model' for a typical karez system and an associated settlement was developed.

Settlements relying on a single karez system for their water supply have a consistent morphology (Fig. 1.2). A typical settlement is situated along a gently and evenly sloping tract of land. The terminus of a karez conduit must occur at a higher elevation than the plots of land to be irrigated. Once the karez opens to the surface (the mouth or *owkura*), canals and channels followed by smaller irrigation paths disperse the water by taking advantage of natural slope and gravity to propel the water forward. Agricultural plots are usually arranged in front of the mouth of the karez and below that elevation. Unlike the hill towns of Italy, Greece, or Turkey, artificial terracing is minimal. Field boundaries are finger-like outgrowths from the flow paths of the irrigation channels and follow the natural topography of the land. There is no attempt to organize the agricultural dwellings—'walled compounds'—inside the settlements according to grid plans or to formal planning principles such as those common in western societies. Most walled compounds are organized in loosely knit groups near the mouth of the karez, where the water reaches the surface and is most readily available for use. If not located near the karez outlet, compounds tend to occur on high ground along one side of the site.

Statistical data was collected from over 40 sites identified as having functioning karezes. These data can be summarized as follows. The lengths of karezes vary from c. 1,000-3,000 m. The mean length is 1,750 m. The topography along the length of a karez system slopes (as measured in Google Earth) at an average rate of around 1% from origin point to site-entry point. Most settlements are 35-55 ha. in size. A single karez system could be expected to supply enough water for a settlement approximately 40 ha in size. Sites with more than one karez corroborate. For example, a site in the southern region of the case-study zone fed by three karez systems is 134 ha in size—roughly three times as large as the single karez model. Therefore, settlement size correlates (not surprisingly) to the capacity of the water supply system.

An operable karez can be identified by its linear pattern of clearly defined "dots," the shadows cast inside vertical access or maintenance shafts (each shaft, a *chah*). With non-functioning karez systems, the patterns of *chahs* are not as clearly defined. Paths of abandoned karez systems often run parallel to functioning ones, which indicates the shifting or relocation of a water supply line (Figs. 1.3-4). Settlements showing multiple phases of karez modification and abandonment may be the oldest ones in the region. This aspect of the research illuminated the dynamic nature of southern Afghanistan's traditional water culture.

The ages of Afghanistan's karezes are notoriously difficult to determine. Local oral histories have been used to date the oldest functioning karezes to no earlier than the 18<sup>th</sup> and 19<sup>th</sup> centuries (McClymonds 1972, 55-6). The Bawran Karez in Herat Province is reportedly 300 years old; this karez was restored in the mid-2000s (Rout 2008, 38-9). Our project's working assumption was that most of the karezes and traces of karezes in southern Afghanistan are in the range of 30-100 years old. Testimonials about the karez as a way of life in modern Afghanistan can be found in mid-twentieth century geographical literature (Humlum 1959, 223-28).

## Year 2 Results

The mapping of karezes that began during reporting Year 1 widened in scope during Year 2 to encompass Helmand and Kandahar Provinces. The mapping methodology was also further developed and refined. Two sources of remotely gathered data were utilized: (1) *medium resolution* Google Earth imagery, which is in the public realm; and (2) FOUO *high resolution* orthorectified aerial photography and LiDAR optical remote sensing data, which are not in the public realm (FOUO data provided by the Buckeye program of the Army Geospatial Center). Imagery acquisition dates ranged from 2004-2011. A GIS database was also begun using ESRI ArcGIS.

The identification of 'active' karezes involved meeting two criteria: (1) Active karezes were identified by linear patterns of clearly defined 'dots' in the landscape that represent the shadows cast inside vertical access or maintenance shafts (*chahs*) of a functioning karez. (2) Active karezes also always lead to a village or agricultural settlement. With inactive or non-functioning karezes, the patterns of dots are not clearly defined. With the oldest inactive supply lines, only muted shadows marking the locations of the maintenance shafts appear (Fig. 1.3). Also, these lines of faded dots in the landscape frequently lead to abandoned villages and agricultural fields (Fig. 1.2). The maintenance shafts of karezes that have been inactive for only a few years are less filled in when compared those that have been inactive for many years. Less than 5% of karezes mapped by the project were indeterminable—categorized as inactive.

The Year 2 mapping results were compared with data previously collected by the government of Afghanistan in the late 1960s. The data from our study suggested that since 1967-8 the numbers of active karezes declined by approximately **11%** in Helmand Province, and **51%** in Kandahar Province.

### **Year 3 Results**

During Year 3 of the project, Stinson, Naglak, and Samz-Pustol dramatically expanded the mapping of karezes to include the entire area of southern Afghanistan—provinces Farah, Nimroz, Helmand, Kandahar, Uruzgan, Zabul, Ghazni, Paktika, Paktya, and Khost. Mapping was completed in July of 2013. Over 5,500 karezes were documented in Google Earth and added to the GIS database (Fig. 1.1).

The completed study identified a relatively small number (620) of recently functioning karezes. With the exception of Helmand and Kandahar, a pattern of near absolute decline in karez usage resounds across much of southern Afghanistan. The new map's multiple 'veins' involving over two thousand inactive karezes stretching some 350 km from Kandahar City to the area southeast of the capital city Kabul provide a striking graphic representation for this trend (Fig. 1.1). The factors in the general decline of the karez in southern Afghanistan are diverse. It is common knowledge that historical events and developments at local, regional, and international scales have strained karez usage in Afghanistan in modern times. Foremost among these factors include attempts to modernize Afghanistan with foreign investment (Shroder 2007), increased movement of populations in both rural and urban areas, cycles of drought (Bhattacharyya, et al. 2004), modern well-drilling (Michel 1972; Qureshi 2002; Whitney 2006; Hussain et al. 2008; Rout 2008), and the consequences of war (Grau and Jalali 1998; Kelso 2001; Cox 2009).

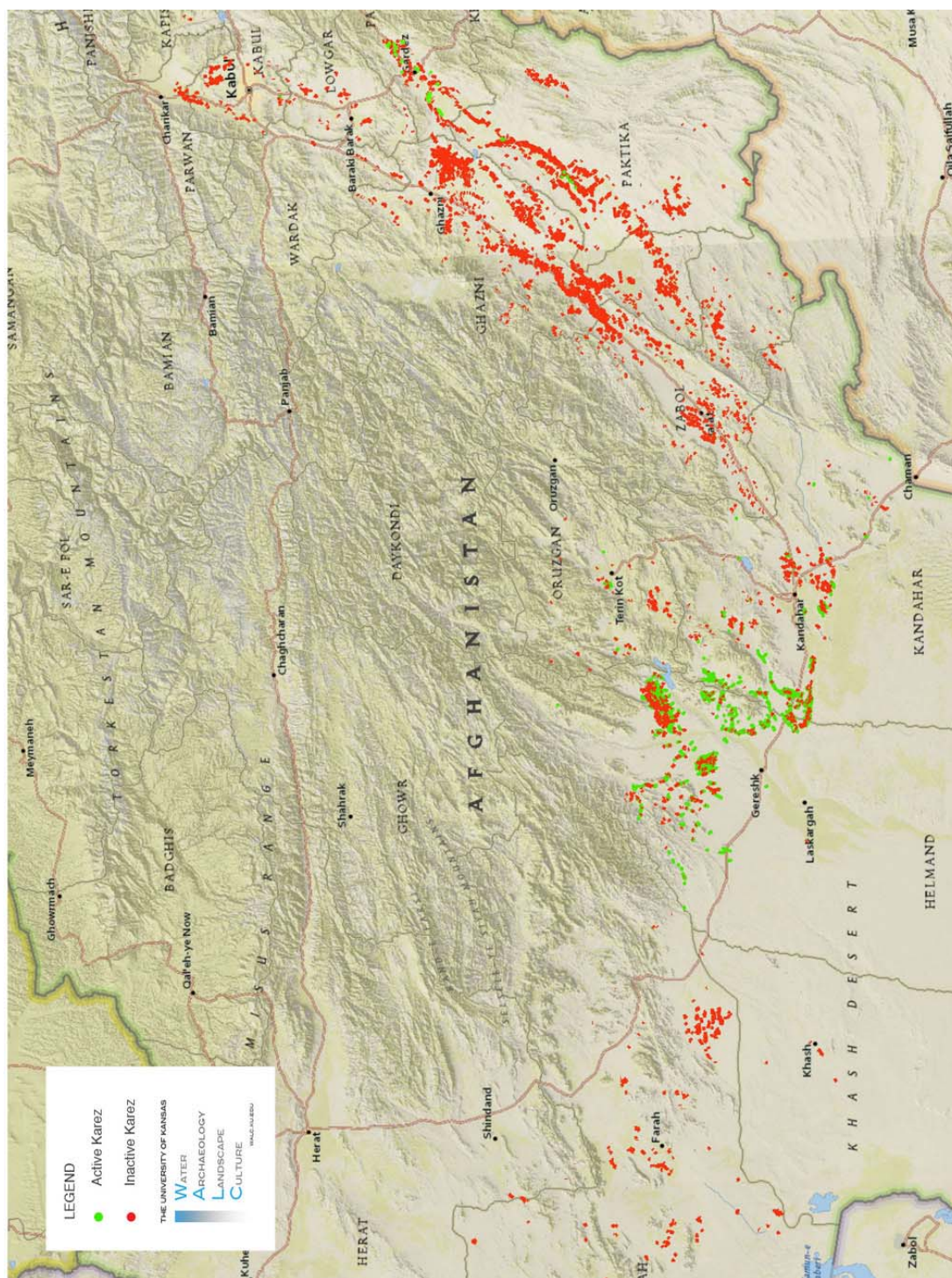
Helmand Province and the western parts of Kandahar Province represent exceptions to the overall trend. Many pastoral communities in these areas of the country still rely on karezes for their primary water supply. It is striking that modernization efforts, mainly the Helmand Valley Project of the 1940s-70s (Callahan 1953; Humlum 1959, 236-61; Dupree 1973, 482-5, 499-507, 634-5), which involved construction of large diversionary dams on the Helmand and Arghandab Rivers, did not result in the utter decimation of the karez way of life in this region.

### **Project Summary and Significance**

The main result and achievement of 3 years of ARO-funded research is a new large-scale map (accompanied by a GIS database) that documents all karezes and traces of karezes in southern Afghanistan (Fig. 1.1). Until 2001 the government of Afghanistan itself relied on karez data from the 1960s in their own internal reports. In 2003, with assistance from the FAO, the government of Afghanistan conducted a new survey of the country's irrigation systems, including karezes (Shobair 2007; Yazdi 2010). However, studies as recently as Hussain et al. 2008 still republish the 1960s data. The current project emerges from this background, and it fills in a void in the historical record for karez use in Afghanistan. A manuscript for publication is in preparation.



## Figures



Stinson Fig. 1. Map Showing Active and Inactive Karezes in Southern Afghanistan  
Based on analysis of Google Earth imagery. Background image: National Geographic Society, ESRI ArcGIS

P. Stinson, M. Naglak, A. Samz-Pustol 8.27.2013



Imagery: Google Earth

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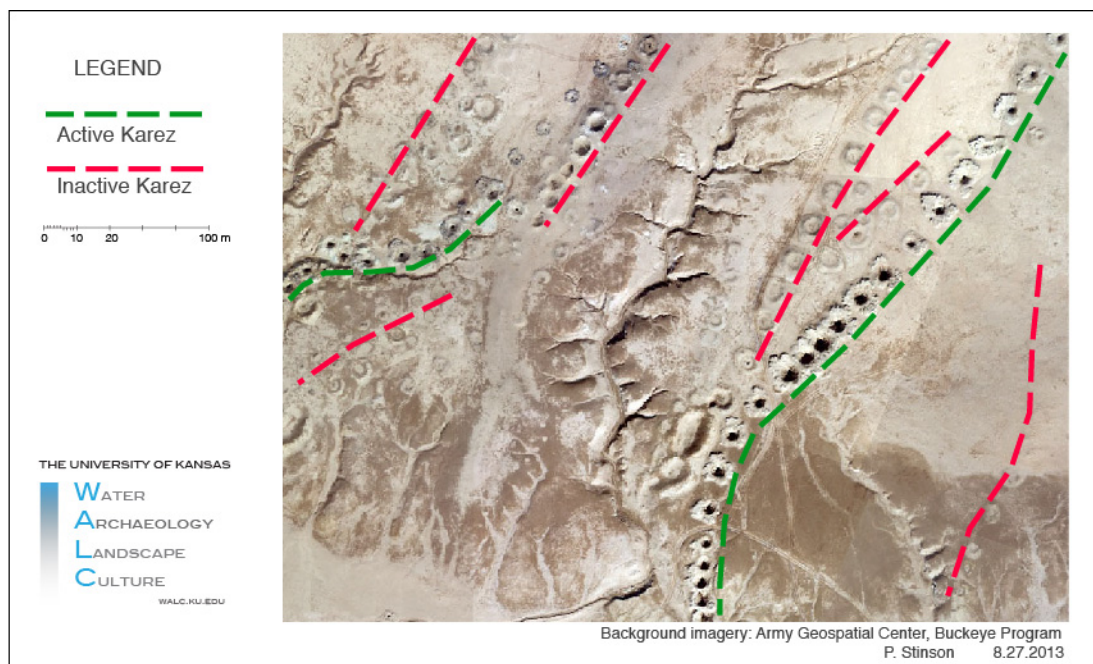


Imagery: P. Stinson

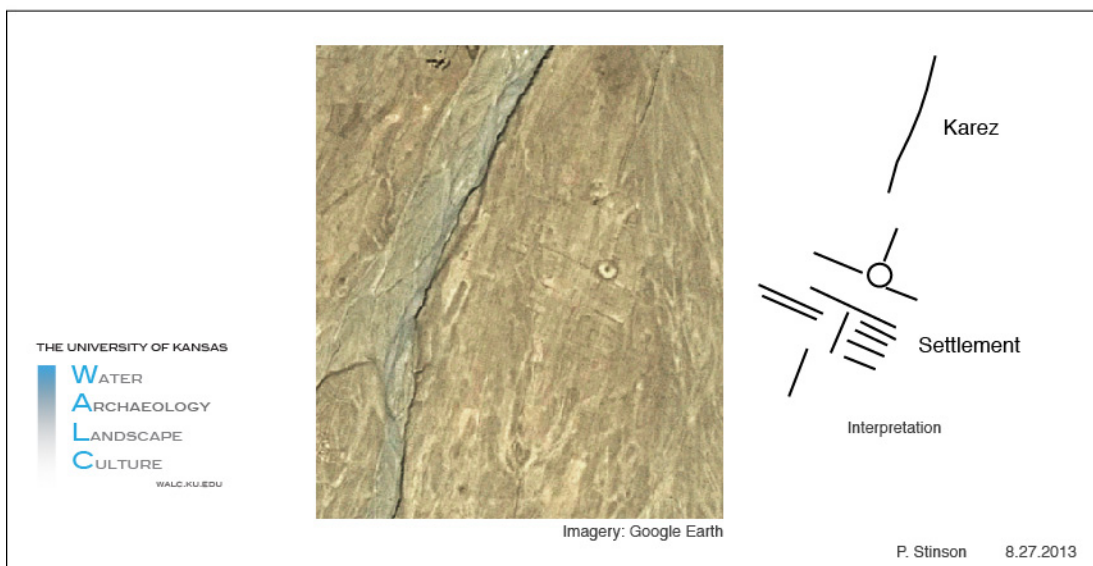
Stinson Fig. 2. A Typical Settlement with a Karez, Helmand Province, Afghanistan

P. Stinson 8.27.2013





Stinson Fig. 3. Active and Inactive Karezes, Kandahar Province, Afghanistan



Stinson Fig. 4. An Abandoned Karez and Settlement, Kandahar Province, Afghanistan



## 2. Final Report on the Remote Sensing Assessment of Karez Irrigation Systems and Archaeological Resources in Kandahar Province, Southern Afghanistan

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*John Hoopes, PhD, Rolfe D. Mandel, PhD, Investigators*  
Department of Anthropology, University of Kansas  
Graduate Student Research Assistant (GRA): Anne Egitto, MA

Over the course of three years of funding, Hoopes and Mandel supervised research on karezes and archaeological features in southern Afghanistan. Data collection, analysis, and interpretation was undertaken by doctoral student Anne Egitto. The focus of this research was evaluation and use of remotely-sensed data from multiple sources in combination with the use of digital geographic information system (GIS) tools to identify and evaluate karez history, use, and archaeological associations. It was undertaken as an exercise in long-distance evaluation in the absence of ground-truthing without on-the-ground archaeological fieldwork, emphasizing the value of the methods described. The results included a comprehensive case study representing extensive documentation and interpretation of karez systems and archaeological remains in a portion of Kandahar Province, southern Afghanistan.

Karez systems are both cultural property and a sustainable, appropriate technology in arid environments and enabled long-term settlements in Central Asia and the Middle East (English 1966: 30; Frye 1996: 13). They are often the only source of water for some villages. Water management principles in Islam focus on sustainability and equality (Faruqui 2001: 23). Karez are sustainable and villagers understand the limitations of diesel pump wells (Fipps 2006: 1). Water is essential for food security and therefore affects sociopolitical stability (Hanasz 2011: 1, 2, 9). Access to water promotes food security not only by improving the quality of lives for Afghans but also facilitates cohesion in the rebuilding process, thereby reducing the causes of social conflict. Food security will play a role in rebuilding both local communities and the state (Hanasz 2011: 1).

### Year 1 Results

Research during Year 1 focused on: 1) creating a bibliographic database of publications relevant to karez studies (a resource expanded through the three-year period of research), 2) documenting the significance of karez in traditional water management in Afghanistan, 3) placing karez within archaeological, historical, and cultural contexts, and 4) creating an inventory of karez and related features (modern settlements, archaeological sites, and other cultural remains) in Kandahar and Helmand provinces. A principal result of Year 1 was the creation of databases karez and associated features in both Kandahar and Helmand Provinces. To create a centralized resource for karez studies, we compiled a bibliographic database of over two thousand articles, books, white papers, theses, dissertations, news and magazine articles, and other printed documents that are directly relevant to karez studies and related issues of cultural heritage documentation and protection. The bibliography is in Endnote with an accompanying digital library of references in Adobe PDF format.

Qureshi (2002) and Hussain et al. (2008) have emphasized the need for a comprehensive database of irrigation systems. In Year 1, we recorded as many karezes as possible using publicly available Google Earth satellite imagery (a process subsequently modified with improved imagery in Year 2). Several scholars have been successful at using Google Earth in archaeological surveys (Contreras and Brodie 2010; Kennedy and Bishop 2011; Myers 2010; Parcak 2009; Thomas, et al. 2008).

The following databases were used to create shapefiles for integration into GIS:

- Catalog of 1547 individual well shafts in Kandahar Province.
- Catalog of 1098 individual well shafts in Helmand Province.
- Catalog of 152 karez in Kandahar Province.
- Catalog of 56 karez in Helmand Province.

Ball's (1982) existing archaeological gazetteer was used in an attempt to establish associations among recorded sites and karez. Using this data, we created two databases of known archaeological sites in Helmand and Kandahar Provinces.

### Year 2 Results

To gain a detailed knowledge of karez use on a more focused, smaller scale, we selected a study area within the Maywand District of Kandahar Province for which high-resolution imagery was available, including historic Corona,

orthorectified aerial imagery from the U.S. Army Geospatial Center (USAGC), Landsat, and LiDAR imagery. The Maywand District study area consists of a rectangular area measuring 11 by 19 km, for a total of 20,900 ha (Fig. 1), approximately 64 km west of Kandahar city. It is situated north of the Registan Desert and more than 63 km from either the Helmand or 11 km from the Arghandab River at altitudes of between 944 m and 1549 m. The primary objectives were to (1) use remote sensing to understand karez construction and modification as well as relocations of surface canals in villages, (2) test various remote-sensing platforms for identification of active vs. inactive karezes, (3) test the utility of an index based on differences in vegetation for determining whether a karez is active or inactive, and (4) identify changes in karez use and the cultural landscape by comparing older Corona imagery (1980) and more recent (2008) orthophotographic imagery.

The methodology included: 1) using the orthorectified imagery to visually examine the landscape and ArcGIS to map karez locations with points, 2) compiling an attribute table with data on each karez, and 3) creating another file using ArcGIS to create polylines (a more complex documentation) to map a karez by tracing the entire system from the mother well to the surface canals. By visually scanning and tracing karez systems in the orthorectified imagery, it was possible to observe changes in karez locations on the landscape and in the courses of surface canals within villages.

One method developed and tested was using Landsat 5 Thematic Mapper Imagery in ArcGIS to calculate normalized difference vegetation index (NDVI) measurements, a test for vegetation vigor that has high potential for revealing active vs. relict karezes. False color Landsat imagery from growing seasons in spring (June 21, 2010), summer (September 9, 2010), and fall (November 15, 2011) (Spring 2010, Summer 2010, and Fall 2011) was used in conjunction with maps of karez locations in the Maywand District to evaluate agricultural vigor, concluding that this methodology can be used to identify active vs. relict karezes. Egitto also used georeferenced Corona imagery to evaluate agricultural activity in settlements using karez systems. Results indicated a greater frequency of positive NDVI values in the spring image, less in the summer image, and even fewer in the fall image. Positive NDVI values correlate with the presence of vegetation. Using GIS, NDVI results were integrated with karez mapping data to determine whether a karez was active or inactive. We conclude that this methodology has high potential for evaluating active vs. inactive karez systems. We identified and mapped 50 karezes—including surface canals and relict portions—in the Maywand District study area, consisting of 25 active, 19 inactive, and six undetermined systems. Each was identified by location, length, and distinguishing features.

This analysis produced a detailed study of portions of the Maywand District in which there is extensive karez use and for which data is available from multiple remote sensing platforms. One result was a detailed inventory of archaeological features, provided as an appendix in Egitto's dissertation (Gazetteer entries – Egitto dissertation appendix). Through a systematic analysis of high-resolution, orthorectified imagery and hillshade models for image modification, we identified 107 significant features as possible archaeological remains. Most of these appear to date to the Medieval Islamic period (AD 900-1200), but some may be as early as the Bronze Age (4000-1500 BC) or Neolithic Period (12,000-4000 BC). We noted their proximity to modern settlements. Egitto classified these into several categories, including circumvallation features (12), mounds (37), *tepes* (9), and *qalas* (walled compounds) (6), also identifying unidentified features such as scars (possibly nomadic encampments; 12), square features (9), and structures (21). Egitto's research produced a gazetteer listing each of these features with precise location, description, detailed photographs and drawings, dates, and comparisons with known features. The methodology developed for identifying and categorizing features is one that may prove useful for other types of constructions.

Despite expectations to the contrary, it was not possible to confirm, much less identify, any specific associations between karezes and archaeological features. This is not to say that both features are not present on the landscape together, only that it was not possible to establish any direct associations.

### **Year 3 Results**

The focus of Year 3 was the integration and interpretation of data. The results of this research were a substantial contribution to her successful completion and defense of a 484-page doctoral dissertation in Anthropology titled "Remote Sensing Assessment of Karez Irrigation Systems and Archaeological Resources in Maywand District, Kandahar Province, Afghanistan." This project was defended at the University of Kansas (KU) on April 10, 2013 with a committed chaired by Hoopes with the participation of Mandel, Philip Stinson (Classics), Ivana Radovanovic (Anthropology), and Stephen L. Egbert (Geography). In response to comments at the time of the defense, a revised version was submitted on April 26. However, submission of a final version has been delayed pending review of content that has been identified as For Official Use Only (FOUO). This draft, with FOUO content, has also been circulated to other U.S. Army personnel. The FOUO data is curated at the Kansas Geological Survey (KGS) at KU.

In her research, Egitto evaluated the benefits and limitations of various sources of data, from satellite imagery and aerial photography, that is available in Google Earth and other public sources to restricted imagery from provided by the

USAGC. The data indicate that: (1) agricultural fields are encroaching on archaeological features, (2) some features have been reused for modern purposes (e.g. mounds for cemeteries, qala walls for cultivated lands), and (3) some features show signs of disturbance that may indicate looting.

Afghan karez in Pashtun society were evaluated within a theoretical framework of landscape archaeology. This approach emphasizes changing geographical settings and cultural perceptions of archaeological sites and features and evaluates Pashtun social organization and concepts of *pashtunwali*, a traditional code of ethics and behavior, especially as they affect the construction and ongoing use of karez. Egitto discusses how karez are constructed and managed, with special emphasis on who has access to water rights, when, and why. She noted that these qualify as “appropriate technology,” that is, constructed and maintained as small-scale, decentralized, labor-intensive, energy-efficient, environmentally sound, and locally controlled operations. Karez systems are not centrally managed. Their construction, use, and maintenance exist entirely within the hands of local farmers.

Egitto tested whether the karez and associated features could be used to identify the presence of social heterarchies or hierarchies in the study area. While inconclusive, case study data (Pain 2010; Pain and Kantor 2010) note that two villages in Dand District, Kandahar, have a hierarchical form of social organization. One generally expects tribes to be egalitarian in nature and heterarchical, but heterarchy and hierarchy can exist simultaneously in the same group (Crumley 1995). A karez will represent either a hierarchical or heterarchical form of social organization based on its initial construction. If a karez is used within a hierarchical form of social organization, as shares are sold in order to maintain the system, the village social organization may become more heterarchical. Comparative data from medieval Europe suggest that extended periods of invasion and occupation promote feudal conditions (Bloch 1961). Feudal conditions are present in Dand District villages and social organization is hierarchical (Pain 2010; Pain and Kantor 2010). Thirty years of conflict have changed the social landscape and individuals with financial and social mobility are able to gain control of the land and resources. In the exploitation of poverty, they are able to subjugate villagers and thus create feudal conditions.

### **Project Summary and Significance**

Our research indicates that: (1) agricultural fields are encroaching on archaeological features, (2) some features have been reused for modern purposes (e.g. mounds for cemeteries, qala walls for cultivated lands), and (3) some features show signs of disturbance that may indicate looting. Analysis indicates that there has not been an increase in karez construction or a decrease in karez use. However, a number of anomalies appear on the landscape that may suggest the use of pump wells. A comparison of the historic Corona (USEROS 1980) imagery to the orthoimagery (USAGC 2008) indicates rural development and a possible population increase, or repopulation that occurred in the center of the study area. Karez do not appear to supply these villages, so it is probable that they obtain their water from another source, such as wells with pumps.

Our research emphasizes the necessity of collaboration between civilian academic institutions and military institutions and officials, especially the significance of regional specialists. If cultural property and the livelihoods of people found in landscapes of conflict are to be valued and protected. Regional specialists are best-qualified to create and provide advice regarding “no-strike” lists used to protect documented cultural property during times of military operations and occupations. Detailed maps assist in disaster relief because the damage to cultural properties is handled differently than “vernacular structures,” (Rush 2013, in press: 10-11). Cooperation is needed. By understanding Pashtun tribal organization, *Pashtunwali*, and local contexts, intervening actors (i.e. military officials, NGOs) can better design/implement projects/programs that will benefit and improve the quality of life of local communities. As a result of water and food shortages and political conflict, populations migrate in search of food or labor (Hanasz 2011: 1). Migration, in turn, contributes to changes in livelihoods and affects social cohesion in local communities/region. Migration also leads to villages being taken over by powerful individuals (Pain 2010; Pain and Kantor 2010).

The Hague Convention provides for the protection of “cultural property” during times of conflict. Egitto recommends a model specifically for archaeological remains and complements those provisions put forth by the Hague Convention (Gerstenblith 2010). This model focuses on archaeological remains and contains four parts: (1) the creation of a “no-strike” list for nonmovable archaeological sites and features, (2) the safeguarding of movable objects, (3) the proactive identification of remaining undocumented archaeological sites, and (4) education about the significance of archaeology as cultural property. Educational training for all military officials, including soldiers, should focus on archaeological concepts, types of local features and artifacts, and the protection of cultural property during conflict.

Our research highlights ethical issues concerning the publication of the specific locations of sensitive cultural features. Archaeological sites with artifacts that have value in the antiquities trade are especially vulnerable to looting when accurate cartographic data is combined with technologies such as Global Positioning Satellite (GPS) navigation. The Afghan government has sought to limit access to this information because they do not have adequate resources to protect

or monitor known archaeological sites. Karezes can also be targets for operations that seek to control or even eliminate rural water supplies. These problems can be exacerbated by data that is already publicly available, as in Google Earth imagery, whose value to armed aggressors planning violent attacks has already been noted.

This research should serve as a comprehensive introduction to karez technology, history, and culture for military personnel. This research provides a foundation for assessing the effects of recent military activity on karez use. The methodologies outlined can be applied to updated, high-quality imagery to assess changes that may have occurred on the landscape. The specific information that has been documented for the Maywand District serves as a case study for data collection and interpretation. It should be disseminated to Provincial Reconstruction Teams (PRTs) in Afghanistan and to the Center for Environmental Management of Military Lands (CEMML).

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### **3. MODELING ANCIENT WATER SUPPLY SYSTEMS: GROUNDWATER FLOW TO A KARIZ IN AFGHANISTAN**

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#### **3.1 Introduction**

In arid regions, there is a long history of successful water-supply systems consisting of hand-dug tunnels in alluvial fan sediments near mountains that provide snowmelt-sourced recharge. These systems were developed in Persia, dating from 3000 years ago (Mays, 2008), and dispersed to the east, west, south and north. The structures were cleverly designed to minimize evaporative loss by harvesting underground water through tunnels, with delivery close to areas of use. Names for these structures vary with region: “kariz” is used in western Afghanistan and other names are used in different regions: “karez” in northern Iraq, Pakistan and in other parts of Afghanistan; “qanat” in Iran; “mambo” in Japan; “galleria” in Spain; “khattara” in Morocco, “foggara” in northern Africa; “felaj” in Oman (McLachlan, 1989; Hussain et al., 2008; Rout, 2008; Lightfoot, 2009). Because the focus of this study is Afghanistan, they will be called karezes in this report. No matter the name, they have similar characteristics: a slightly dipping tunnel that taps the water table in an alluvial fan aquifer proximal to the mountain range; horizontal shafts used for initial tunnel construction, maintenance

access, and aeration; and water delivery near the point of use more distal in the alluvial fan. These structures have been traditionally installed and maintained without mechanized devices and they deliver water by gravity alone, making them a relatively inexpensive water source especially adapted for rural water supply and irrigation in developing countries. They deliver the most water in the spring and early summer, when crops require irrigation, and the least water in the late fall and winter, when irrigation water is less needed, making them relatively efficient (e.g., Beaumont, 1989). They have an advantage over surface water sources in many areas of Afghanistan, because the surface water sources are often dry during all or parts of August to November due to less snowmelt and extensive diversion for irrigation (ERDC, 2002).

Recent reports of numbers of Afghanistan karezes no longer yielding water vary, but all agree that significant numbers of karezes and shallow wells are going dry or producing less water. Shobair (2002) reported that all traditional irrigation systems (karezes and structures diverting river water) have experienced reduced flow or complete drying, with 60-70% of karezes and 85% of shallow wells completely dry. Shobair and Alim (2004) reported 36% of karezes dry, and the remaining operating karezes with flow reduced as much as 83%. From 2004-2007, one well monitored by the USGS in the Kabul Basin showed a water table decline of about 2 meters, while another well saw a water table rise of about 4 meters (USGS, 2010), suggesting non-uniform decline in water table, a phenomenon not uncommon in heavily used aquifers (e.g., McGuire, 2013). In the Kandahar area, comparison of water-level measurements from the early 1970's with those in 2003 reveals water table declines of about 6 to 20 meters in all 6 wells reported (CDM, 2003).

A warming climate can be expected to reduce snowfall in the Hindu Kush, and thus reduce recharge to alluvial fan aquifers flanking the Hindu Kush. From 1950-1990, there was a linear increase of average annual temperature of 0.07° per decade in the area (Nasrallah and Balling, 1993). Predictions for future climate in the region include a decrease in meteoric precipitation (10% over the next 50 years) and continued warming (Mack et al., 2010). Groundwater recharge is about 10% of annual meteoric precipitation (Uhl et al., 2003), so a decrease in precipitation will result in a decrease in recharge of near-surface aquifers. Climate warming is addressed in Phase 2 report.

Reported water flow rates, including within a kariz and at the outlet of a kariz, range from ~3-500 liters per second in Afghanistan, Pakistan and Saudi Arabia. Thus, a single kariz can supply domestic water and irrigation for 10-200 hectares (Uhl, 2006). In the 20<sup>th</sup> century, karezes supplied 8% of all water in Afghanistan.

Increasing population puts an increased demand on water, and without groundwater recharge matching or exceeding water use from water wells, aquifer water levels will decline. Population assessment is addressed in Phase 2 report.

The goal for this Phase 1 project was to generate a computer model simulating the groundwater environment in the vicinity of a kariz in order to understand how water is produced by a kariz. In light of projected climate change, the goal for Phase 2 work was to determine the sensitivity of kariz water production to changes in groundwater conditions and water demand.

### **3.2 Review of Prior and Present Accomplishments**

The accomplishments in Phase 1, Year 1 on this project were:

- 1) assembled a lexicon of terminology associated with a kariz (Appendix 3.1)
- 2) revised the conventional conceptual model of a kariz in light of sound hydrogeologic principles
- 3) constrained model input parameters through literature searches for values related to (Appendix 3.2)
  - a. kariz dimensions
  - b. hydraulic conductivity
  - c. kariz water outflow rates
  - d. seepage loss through the kariz bottom
- 4) created a preliminary model that demonstrates the water table disturbance by a kariz
- 5) considered the "wetted" surface area of the kariz as a function of model boundary conditions and in comparison to a typical water-well screen
- 6) accumulated information on the history of local meteoric precipitation, in preparation for simulating effects of change in recharge due to climate change on kariz water production

In Phase 1, Year 2 accomplishments on this project were:

- 1) placed the kariz in a landscape and hydrogeologic perspective
- 2) worked with in-theatre U.S. Army personnel to attempt to get onsite geologic and hydrologic data for use in the model
- 3) refined the earlier model to better characterize the "capture zone" of the kariz (the width of the water table disturbed by the kariz), which is ~30 m in the most recent models, and continue sensitivity tests of the kariz to hydraulic conductivity and model boundary conditions
- 4) contrasted water flow into and out of the kariz in the modeling domain



- 5) interpreted the susceptibility of kariz water production to change in water table elevation, considering the maximum gradient in the kariz

In Phase 1, Year 3 (extension year) accomplishments on this project were:

- 1) extended the validity of the estimated hydraulic conductivity using grain size parameters from soil samples collected in Afghanistan
- 2) improved the computed model of the kariz by using the “drain” function to simulate water production from the kariz
- 3) improved the delineation of the capture zone of a kariz

### 3.3 Setting

The general study area is southwestern Afghanistan, Helmand Province, in the vicinity of Kandahar. In Afghanistan, the Hindu Kush mountain range, the western extension of the Himalayas, splits the country into a slightly more humid northern region and a more arid western, southern and eastern region. The Hindu Kush has historically trapped snow from weather fronts moving inland from the Mediterranean Sea in the winter and from the Indian Ocean in the summer (Favre and Komal, 2004); most of Afghanistan only receives winter precipitation, with only the easternmost portions of Afghanistan benefiting occasionally from the remnants of the Indian summer monsoon. Besides mountain snow, during the winter season the most effective liquid precipitation falls gently during the “Chel-i Buzurg” or “big 40 days” starting ~21 December; heavier rainfall starting near the end of February can cause flash flooding and contribute little to groundwater recharge (Favre and Komal, 2004).

Figure 3.1 identifies locations of sites used to accumulate various kinds of data for input to the model.

The karezses are easily visible in even the Google Earth environment (fig. 3.2), appearing as chains of roughly circular craters (vertical shafts accessing the subterranean tunnel) in alluvial fan materials adjacent to the Hindu Kush that lead to a settlement. Some of shafts can appear filled in, and in this case there is often a sub-parallel set of shafts close by.

Figure 3.1:

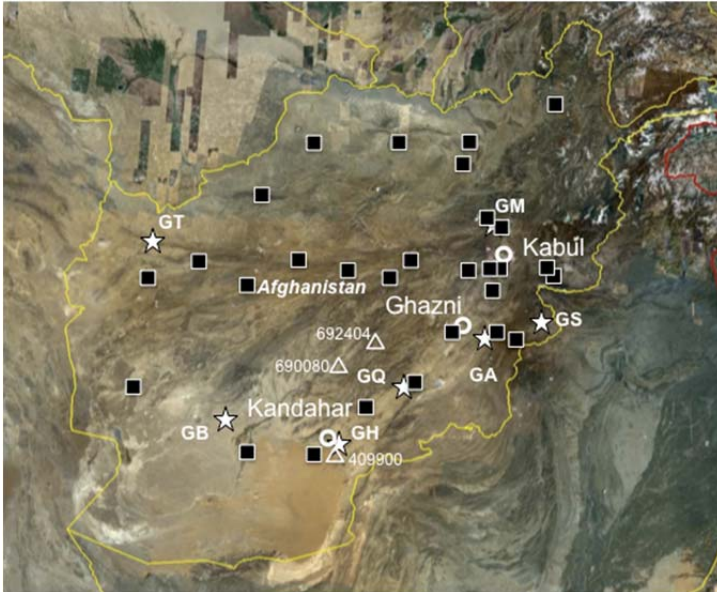


Figure 3.1: Study area for representative karez model is south-central Afghanistan, north of Kandahar. Major cities are shown as open circles, soil sample locations (J. Kelley, personal communication, 2010) as white stars, historic meteorological stations (Favre and Komal, 2004) as filled squares. Modern meteorological stations used in this study with data available online (NOAA Climate.gov) are shown as open triangles with NOAA identification number. Wells with  $K_h$  from pumping tests are near the cities of Kandahar (CDM, 2003) and Kabul (Tunnermeier and Houben, 2005).



Figure 3.2:



Figure 3.2: Enhanced Google Earth image of a karez, showing the vertical access shafts (chahs) and outflow channel leading to irrigated farms.

### 3.4 Methods, Kariz Modeling

The computer model employed for this study is Visual MODFLOW (Schlumberger, 2009), which is the U.S. Geological Survey model MODFLOW (USGS, 2012) combined with a graphical interface.

Hydraulic conductivity distribution in the model (alluvial fan material) is based on average of reported values from pumping tests in the general area (see ARO interim report, 2011) as newly estimated hydraulic conductivities from soil samples collected in Afghanistan (Fig. 3.3a).

Characteristics of a typical karez are tabulated in Appendix 3.2.

The modeled kariz tunnel occupies  $1 \text{ m}^2$  cross sectional area by a length equivalent to ~half of the model domain length. The kariz is centered in the domain. Gradient on the simulated kariz tunnel is no steeper than 1:1000, a maximum gradient to minimize fluvial erosion of the tunnel structure by water flowing in the kariz.

The boundaries are fixed head at the upgradient and downgradient ends, and no-flow at the sides and bottom of the domain. The water table constitutes the upper boundary.

To calibrate the computer model, we adjusted hydraulic conductivity to match kariz outflow to an average of published kariz water flow rates.

Fig. 3.3 shows the data used to determine a representative hydraulic conductivity of  $70 \text{ m day}^{-1}$ .

Figure 3.3a:

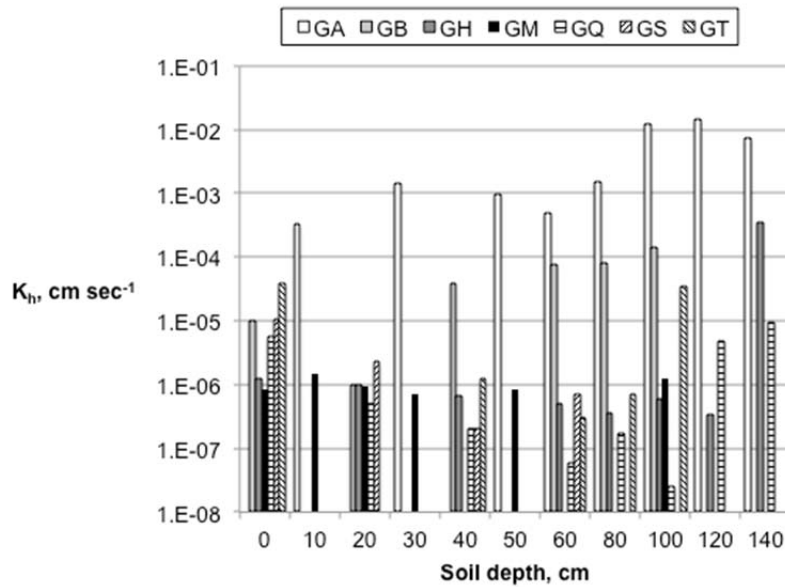


Figure 3.3b:

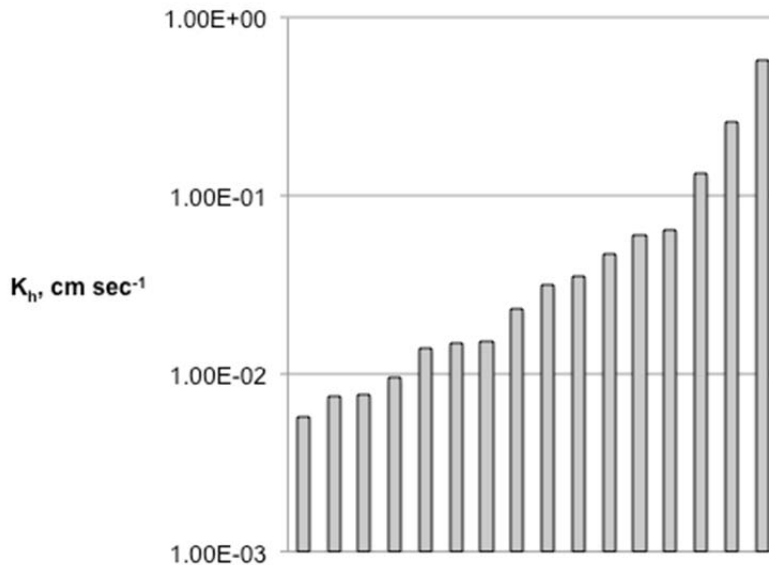


Figure 3.3: Hydraulic conductivity ( $K_h$ ) of karez materials. a)  $K_h$  estimated using the Hazen equation and  $d_{10}$  of soil samples collected in Afghanistan. Almost all are greater than  $10^{-7}$   $\text{cm sec}^{-1}$ , which is an approximate minimum for aquifers. Outlined bars are samples from alluvial fans. Others are samples from floodplains or other locations covered by alluvium. (J. Kelley, personal communication, 2010. Grain size data from Dr. Jason McKenna, Julie Kelley, Dr. Lillian Wakeley, and Sam Jackson through U.S. Army Engineering Research and Development Center.) b) Results of pumping tests near Kandahar (CDM, 2003) and in the Logar River alluvial aquifer in the Kabul basin (Tunnermeier and Houben, 2005).

Soil samples to a depth of  $\sim 1.5$  m in alluvial materials in Afghanistan (J. Kelley, personal communication, 2010) have estimated hydraulic conductivities ( $K_{h,e}$ ) consistent with aquifers (fig. 1 and 2a): average  $K_{h,e}$  of those soils on alluvial fan material is about  $2 \times 10^{-5}$   $\text{cm sec}^{-1}$ , which is in the range of productive aquifers.  $K_h$  determined from pumping test results near Kandahar and in the Kabul Basin (CDM, 2003; fig. 2b) are higher still, with average  $K_h$  about  $8 \times 10^{-2}$   $\text{cm sec}^{-1}$  ( $\sim 70$   $\text{m day}^{-1}$ ). The latter value is similar to the  $K_h$  used by Mack et al. (2010) for fan alluvium and colluvium ( $50$   $\text{m day}^{-1}$ ) and river channel sediments ( $100$   $\text{m day}^{-1}$ ) in the Kabul Basin. For computer modeling of groundwater flow to a karez, we assigned the computer model domain a horizontal  $K_h$  ( $K_{h,h}$ ) of  $70$   $\text{m day}^{-1}$  and vertical  $K_h$  ( $K_{h,v}$ ) of 10% of  $K_{h,h}$ . In distal alluvial fan sediments, it is expected that finer-grained sediments should be encountered with depth, such that hydraulic conductivity will decrease with

depth. For these initial simulations, we did not have enough data to quantify any depth- or spatial-dependent  $K_h$ , and will reserve exploring the effects of variable  $K_h$  for future work.

Elevated hydraulic conductivity was used to simulate water flow through the kariz tunnel, after thorough tests to find the hydraulic conductivity above which flow rate did not change, but below which the model would converge numerically. Use of the drain and pumping well modules in MODFLOW to simulate the kariz outflow were tested, as well, to better represent removal of water from the groundwater system.

### 3.5 Results

The conceptual model designed for kariz interaction with the water table suggests that the kariz forces the water table to coincide with the location of the bottom of the kariz (fig. 3.4). During the wet season, the entire length of the kariz is in contact with the water table; during the dry season, when the water table drops, less of the kariz is in contact with the water table and thus less water is produced by the kariz.

Figure 3.4:

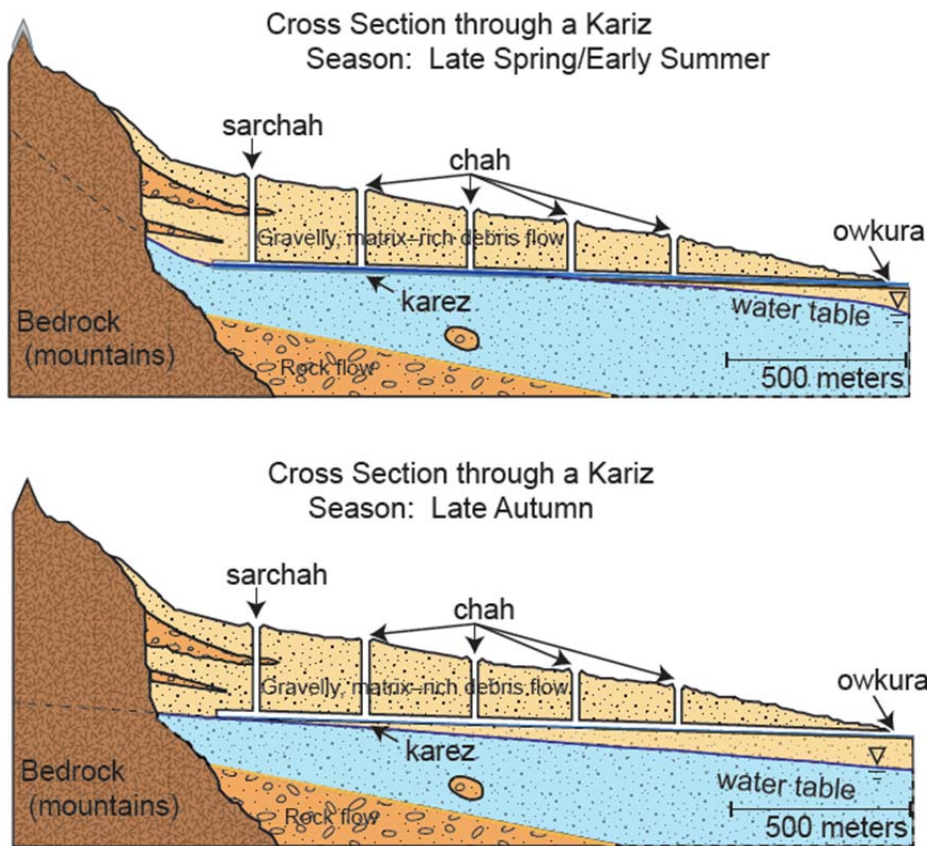


Figure 3.4: Conceptual diagram of a functioning karez, showing the subhorizontal tunnel following the water table of the aquifer, except at the downstream end, where seepage loss may be substantial.

The kariz disturbs the water table by acting as a drain to the alluvial fan aquifer (fig. 5). On the upgradient side of the domain, hydraulic head contours are distorted into a narrow U-shape with the opening of the U facing upgradient, indicating flow of water toward the kariz. On the downgradient side, hydraulic head contours are distorted into a narrow U-shape facing downgradient, indicating flow of water out of the kariz into the alluvial fan sediments. (This simulation did not employ the modules of a drain at the end of the kariz or a pumping well at the end of a kariz that would remove the water flowing through the kariz from the aquifer system.)

The width of the domain affected by the kariz is narrow, at a maximum of about 10 m.

The hydraulic head change in the kariz (and water table) is determined by the kariz gradient, and so, over a distance of 2 km, is 2 m (gradient of 1:1000) to 1.3 m (gradient of 1:1500).

Figure 3.5a:

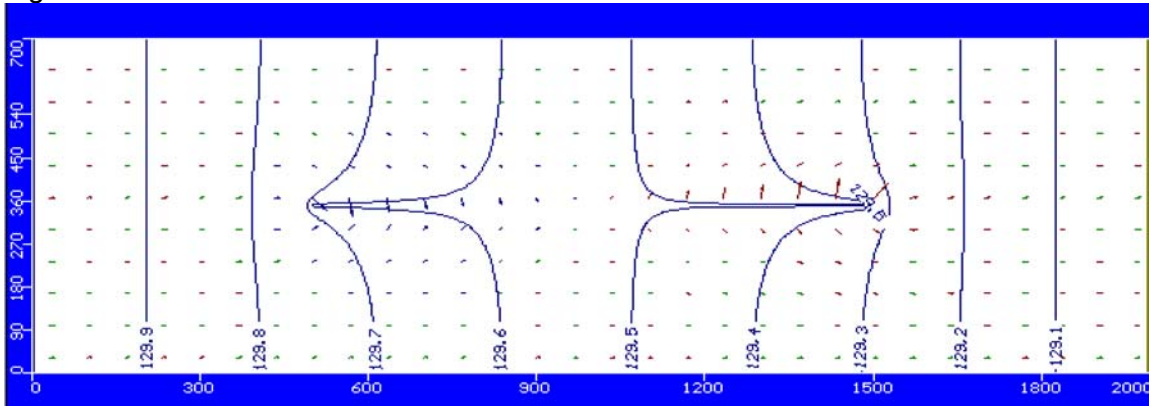


Figure 3.5b:

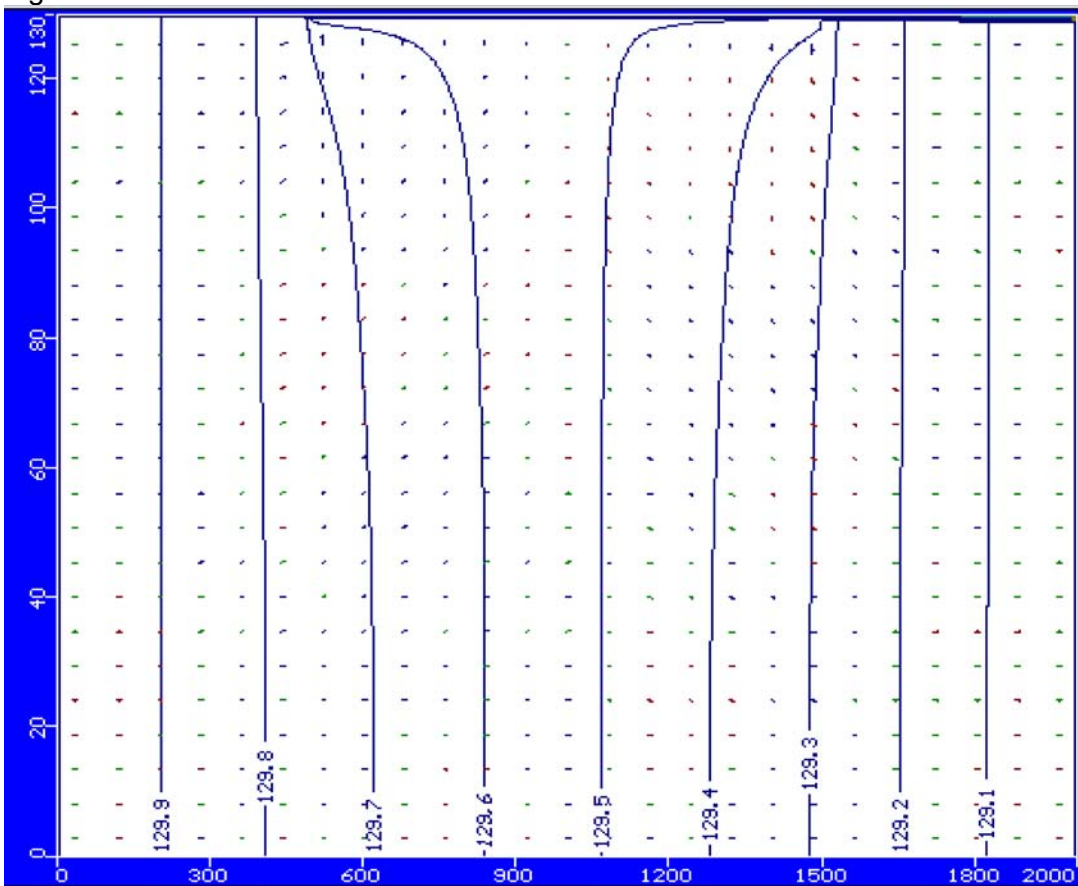


Figure 3.5c:

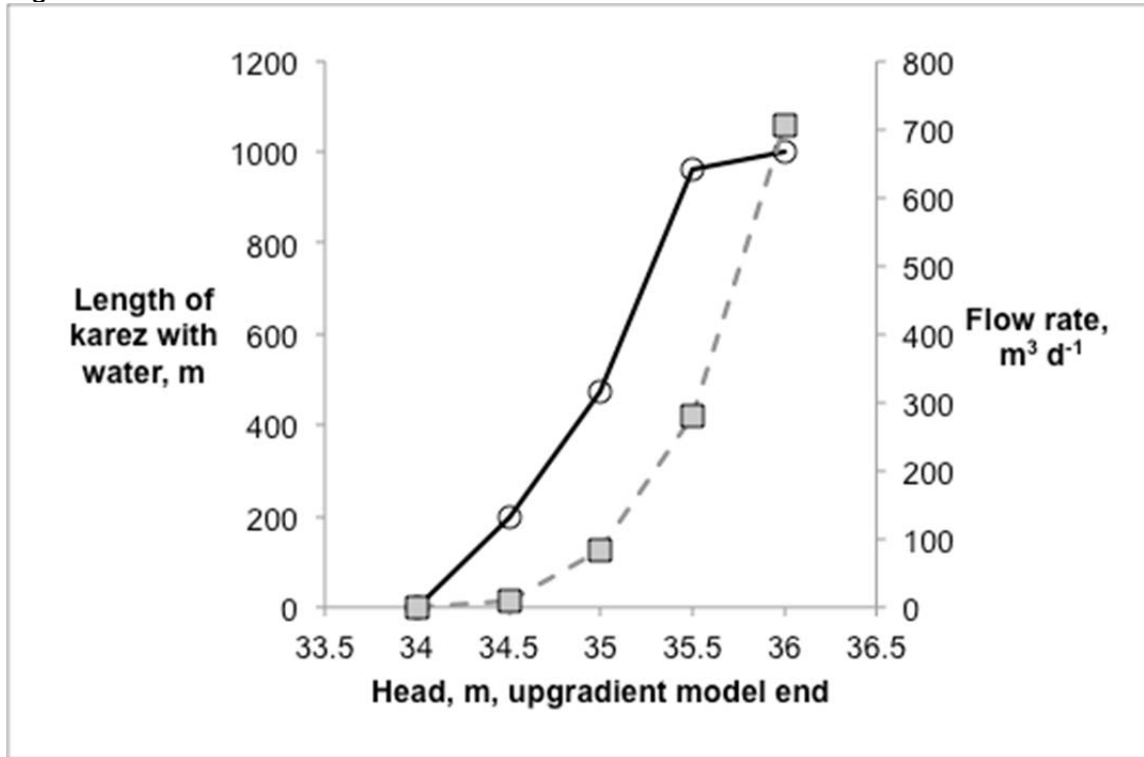


Figure 3.5: Example of modeling results. a) Map view at the water table showing the effect of the karez on head distribution. b) Cross section from proximal alluvial fan on the left to distal alluvial fan on the right along the karez, showing the shallow capture zone. c) Effect of the slope of the water table on the length of the karez in the saturated zone and the water

flow in the karez. Downgradient fixed head is always 34 m, so head difference ranges from 0 to 2 meters. Filled squares are flow rate in the kariz in  $\text{m}^3 \text{d}^{-1}$  and open circles are the length of the kariz in contact with the water table, in meters.

### 3.6 Interpretations

The computer simulations demonstrate validity with respect to kariz water flow rates. These simulations employ a uniform hydraulic conductivity distribution, except that the water flow within the kariz is created by very high hydraulic conductivity. Flow in the karez is basically driven by the fact that the kariz is situated at and, to a certain extent, controls the depth of the water table. The hydraulic head distribution shows that the kariz acts as a drain to the alluvial fan aquifer in the upper portion, in that it draws water toward itself, and acts as a source of water in the lower portion, when water is not removed from the groundwater environment through a drain or pumping well. The latter finding is determined by the lower boundary of the model, which, in these simulations, is close to the physical end of the kariz. Seepage loss in karezes has been well documented (Kahloun et al., 1988), so that this finding, although determined by the chosen boundary conditions, is valid.

The narrow width of the disturbance in the hydraulic head contours (capture zone) by the simulated kariz supports the observation that multiple kariz often occupy any single valley. Although we have not simulated multiple kariz in a single domain, it can be predicted from present model results that a lateral spacing of ~30 m or more is adequate to prevent interference of water production from one kariz by another.

The small change in hydraulic head (1.3 m to 2 m) over the length of the kariz (2 km) demonstrates how vulnerable water production from the kariz is to reduced groundwater recharge. Although quantitative reports on seasonal water production from karezes are not available, some qualitative accounts report strong seasonal control on kariz water delivery rates. The small change in kariz elevation over its length suggests high sensitivity to changes in groundwater recharge. The predicted reduction in snowfall in the Hindu Kush, and the natural dependence of groundwater recharge in alluvial fans flanking the Hindu Kush, suggest that kariz at higher elevations are likely to stop producing water before those at lower

elevations which are likely producing older, farther-travelled water. Eventually it appears likely that even kariz at lower elevations will stop producing water, as water table elevations fall.

Many more computer simulations were run during the course of this project. These are listed in Appendix 3.3.

### 3.7 Conclusions

A successful groundwater model of a typical kariz shows that the kariz drains water from alluvial fan sediments in its upper half and loses water to alluvial fan sediments in its lower half. The uniform hydraulic conductivity distribution used in these simulations is a simplified representation of alluvial fan conditions, an issue that will be addressed in future work. The model demonstrates that karezes have a small effect laterally on the water table, thereby allowing for multiply kariz to produce water within a single valley without interfering with each other. Seepage losses in the lower half of the kariz may provide an opportunity for future groundwater exploration, if future modeling of larger domain with groundwater discharge reaches (river) and variable hydraulic conductivity distribution show elevated hydraulic head in the regions below the lower half of the kariz and downgradient of the kariz.

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#### **4. LANDSCAPE MODELING AND SURFACE-WATER HYDROLOGY WITH EMPHASIS ON KAREZ IRRIGATION SYSTEMS IN AFGHANISTAN**

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The initial objective of this component of the Phase One project was development of a GIS-based compilation of available imagery and related databases. Available public, commercial and unclassified military imagery relevant to selected study areas in Afghanistan were acquired, catalogued, and processed as needed (e.g., geo-referencing). Other spatial data were compiled, e.g., Soviet-era topographic maps, US Geological Survey geologic maps. These databases were then incorporated in the visual and quantitative characterization of a drainage basin representative of those regions of Afghanistan where the karez irrigation system has been adopted.

Specifically, this section (4.) includes visual rendering of the study area (4.1), depiction and characterization of the karez irrigation systems (4.2), visualization of the impact of drought on the landscape (4.3), development of landscape models (4.4), highlighting of remotely-sensed geochemical anomalies (4.5), generation of surface-water pathway and slope models (4.6), and development of flood-water inundation scenarios (4.7).

##### **4.1 Geographic information system database development and landscape modeling**

Mapping for the project, which is being conducted in a geographic information system (GIS), has required the compilation of databases which have been utilized in the characterization and mapping of ground features. Three types of databases have been compiled: (1) Elevation data, (2) 2-D spectral and other imagery, and (3) non-georeferenced maps and photographs in portable document format (pdf) and various other image formats (e.g., jpeg, tiff).

All data compilation and manipulations are being conducted on two state-of-the-art GIS work stations within the Department of Geography at the University of Kansas. Because much of the data is FOUO, appropriate measures are being taken to keep all data (primary and backup) secure.

##### **4.1.1 Elevation data (X, Y & Z data)**

Light Detecting and Ranging (LiDAR) data, which consist of multiple laser pulses per pixel from an airborne platform, in this case drone-acquired (DoD), provides limited coverage of the study area. X, Y, and Z are each about 1-m resolution. Complete coverage is, however, available in Interferometric Synthetic Aperture Radar (IFSAR), though resolution is less at about 5 m.



These data sets have been loaded into various formats (GRID, Mosaic), and then tiled to facilitate their use in analysis processes. Optimization of these datasets has produced GIS layers and maps including:

#### *Hillshade*

Produced using ArcMap tool, used for visualization of terrain

#### *Shaded Relief*

Produced using ArcMap tool, used for visualization and may be used as input mapping as a tool for landscape segmentation and classification

#### *Slope*

Used as a tool for characterization of surface attributes

#### *Vertical Difference*

Using both LiDAR and IFSAR data, depressions were identified using ESRI's ArcMap Hydrology tool set. Filling depressions creates a filled surface, which was differenced with the original elevation data. The differences are being used for a number of applications such as the mapping of chahs (vertical access shafts) for the karez irrigation systems. LiDAR data, in particular, provided good visualization and aided in the mapping chahs. IFSAR data contained noise and are of sufficiently low resolution as to limit their utility, though the largest (highest relief) chahs are detectable.

#### *Basin*

IFSAR data and hydrology tools were used to delineate watersheds (drainage basins) and associated parameters such as basin area. LiDAR data coverage is incomplete and could not be utilized.

#### *Geostatistics*

Principal component analysis is being performed on the bare-ground, first and last returns. The 2nd and 3rd components are proving useful in highlighting categories of landforms, expressed as a "Difference map." Intensity data are yet being investigated for application as a proxy for soil character, e.g., particle size. Stripping and tile illumination differences associated with flight line and surface slope characteristics will need to be overcome before these data will be assessable.

#### *3-D*

LiDAR data have been used where available to provide visualization of surface features, e.g., chah depth. Features have been mapped, and attempts to visualize these features using 3-D ArcScene are in progress, but data for depth are absent where chahs and other small depressions do not have good aspect with the sensor. Attempts are being made to interpolate depths using 3-D analysis tools in ArcScene. IFSAR data are being employed to visualize and characterize features. Imagery, shape files and layers are being combined to provide excellent visualization of features.

### **4.1.2 Multispectral and other imagery (X & Y)**

Landsat data multi-spectral data have been collected since the 1970s, providing a temporally extensive database readily available from the US Geological Survey. Resolution varies but is typically about 30 m, and 8 spectral bands are normally measured. Examples of derived data are color IR, clay content of soils, and Normalized Difference Vegetation Index (NDVI), a measure of plant vigor useful herein to monitor fields.

Orthophotography (DoD) coverage intersects that of the LiDAR data and is of much higher resolution, which has made it extremely valuable for mapping surface features, e.g., small drainages, vegetation classification and density, and cultural features such as agricultural fields, structures (including those in ruins) and chahs. In addition to being a valuable mapping tool, it has provided a visual check for other data layer outputs, e.g., Landsat spectral data maps, Google Earth® imagery, and has the potential for "calibration" of IFSAR and other databases to extract more information from them than would be possible otherwise.

SPOT (SPOT Image—France), like Landsat, is a multispectral, as well as panchromatic sensor. Though normally of relatively high resolution (~2 m), coverage purchased for the study area is of poor quality and largely unusable.

The Advanced Spaceborne Thermal Emission Reflection Radiometer (ASTER—JAROS, Japan) produces several band of data at varying resolutions. Given the narrow short-wave and thermal infrared band widths, specific bands and band ratios can be used as proxies for carbonate, quartz, iron and other soil constituents. Appropriate coverage has been requested.



Other sources of high resolution (1-2 m), multispectral imagery for the study area include IKONOS (Space Imaging) and QuickBird (Earthwatch). Samples of these products for the study area are being evaluated and will be acquired as deemed necessary.

#### 4.1.3 Non-Georeferenced Maps and other Documents

Several sources and products have been obtained, but thus far the most useful are those available through the US Geological Survey's, which has several programs in Afghanistan, each producing a wide array of data sources. In particular, quadrangle maps at 1:250,000 scale are produced as geologic maps, natural-color-image maps, Landsat false-color image maps, and topographic maps. Topographic maps have been derived from Shuttle Radar Topography Mission (SRTM) data, with gaps being filled in with digital raster graphics generated from the 1:200,000 scale Soviet General Staff Sheets (dated between 1978 and 1997). We currently have pdf versions, but will soon be acquiring the original georeferenced shape files, etc. from the USGS. Our database includes the Soviet-era topographic maps, which have been completely georeferenced (Fig. 4.1).

The Corona program (CIA) produced high-resolution photographs from satellite-based platforms in the 1960s, which have been declassified. These black and white photographs, though limited in coverage, have become a source of detailed historic information for our study area.

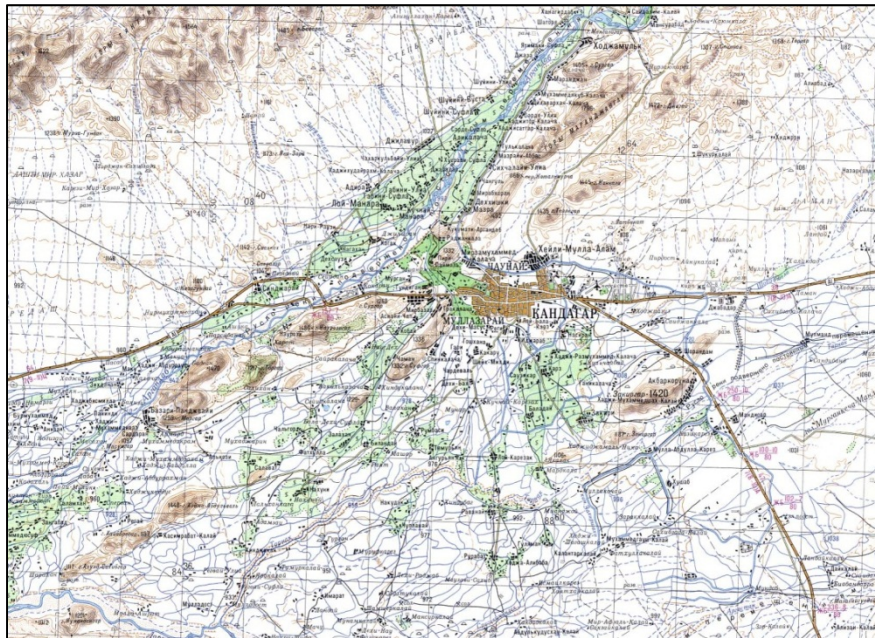


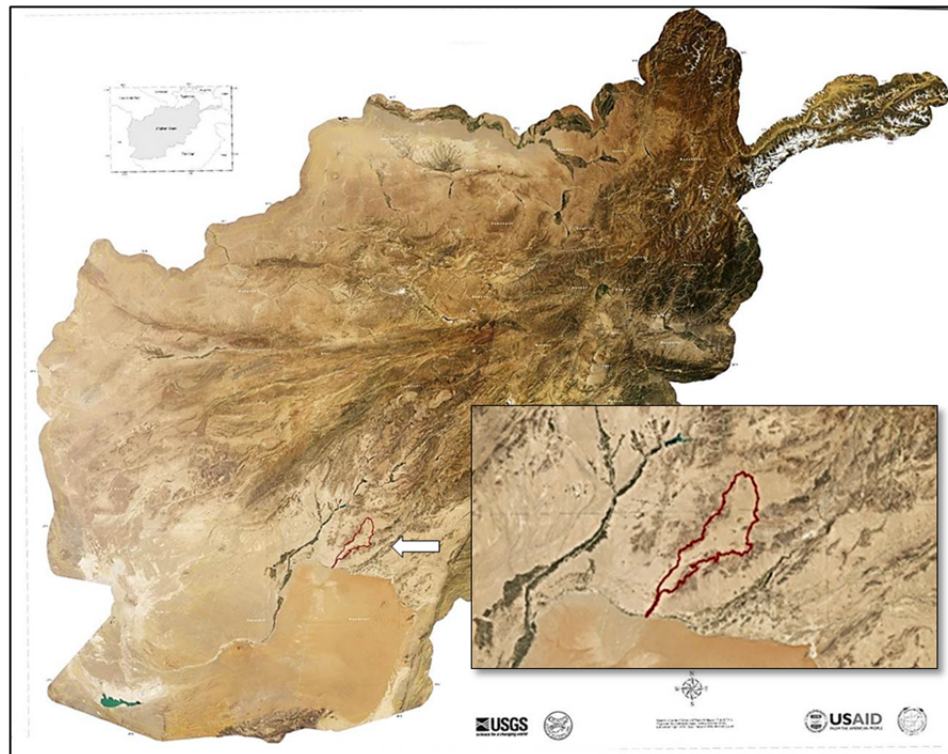
Figure 4.1. Soviet-era (Soviet General Staff) topographic map (1:200,000) of the Kandahar area. This sheet has a contour interval of 30 m. (USGS)

#### 4.1.4 Study Area and Digital Terrain Models

Most of the groundwater and surface water available in southern Afghanistan comes from precipitation and snowmelt in the Hindu Kush Mountains of northern Afghanistan. This water becomes available in the south as spring meltwater and limited rainfall occurs. Much of the surface flow infiltrates the alluvial fans and aprons flanking the Hindu Kush on the south. The Kandahar area and west exemplifies this water resource environment. Accordingly, this region has become the country's focus for the adoption of karez irrigation.

A representative drainage basin was selected for landscape analysis and modeling in the context of karez development. The study basin is located about 565 km southwest of Kabul and 65 km west of Kandahar; one of the many settlements in and adjacent to the basin, Pir Zadeh, was used to designate the basin. Being east of the Helmand River, this basin drains into the Arghandab River, a westward-flowing tributary to the Helmand River (Fig. 4.2).

Geology for all of Afghanistan was mapped by R. Bohannon and colleagues of the USGS, and published as a series of 1:250,000 scale maps. Geology for the Pir Zadeh basin (Kandahar Sheet: O'Leary and Whitney 2005) consists of Quaternary alluvium and colluvium flanked primarily by the older Cretaceous and Triassic igneous rocks (Fig. 4.3).



*Figure 4.2. Natural-color image mosaic of Afghanistan with location of the Pir Zadeh study drainage basin outlined in red. South of the basin lies the Registan Desert. (USGS map)*



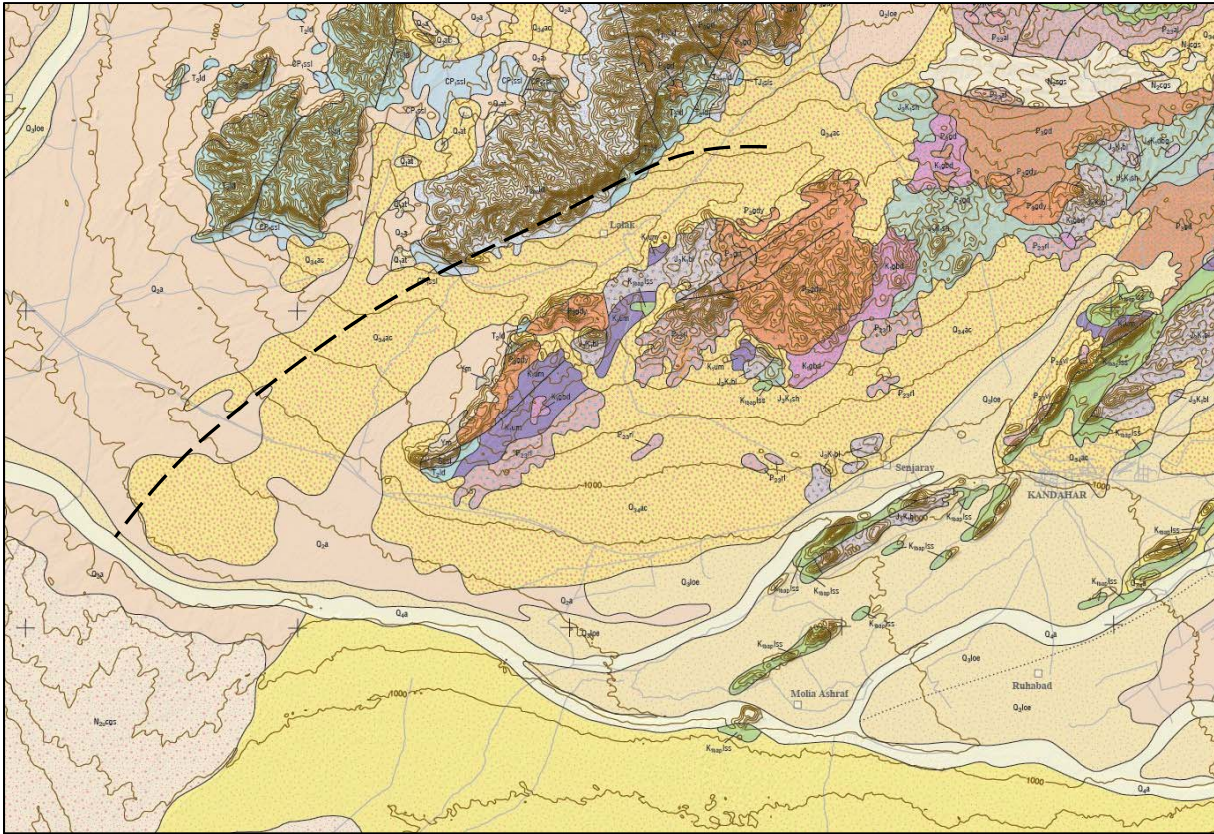


Figure 4.3. Surficial geology of the Kandahar area, with contours. The Pir Zadeh drainage basin is indicated by the dashed valley axis line. Basin valley fill (yellow: Q<sub>34ac</sub>) consists of Quaternary alluvium and colluvium with remnants of high terrace of the Arghandab River (tan: Q<sub>2a</sub>), whereas the flanking ranges are Cretaceous and Triassic igneous and metamorphic rocks. (O'Leary & Whitney, USGS Geologic Map of the Kandahar Region, 2005)

A hillshade, digital elevation model (DEM) of the Pir Zadeh drainage basin has been derived from IFSAR data (Fig. 4.4), as well as a false-color (red) NDVI database draped on the IFSAR data (Fig. 4.5). This model development was used to delimit first-order geomorphic zones within the basin. From the water-resource perspective, this mass of alluvial-fill aquifers comprising the bulk of the basin is divisible into an upper basin (structural?) fill, flanking alluvial aprons and fan complexes, and an inset alluvial fill associated with the modern braided channel system and its late-Pleistocene ancestors. NDVI data for the basin and environs were extracted from a July 2000 scene; these data indicate irrigated field locations and sizes during this drought year.



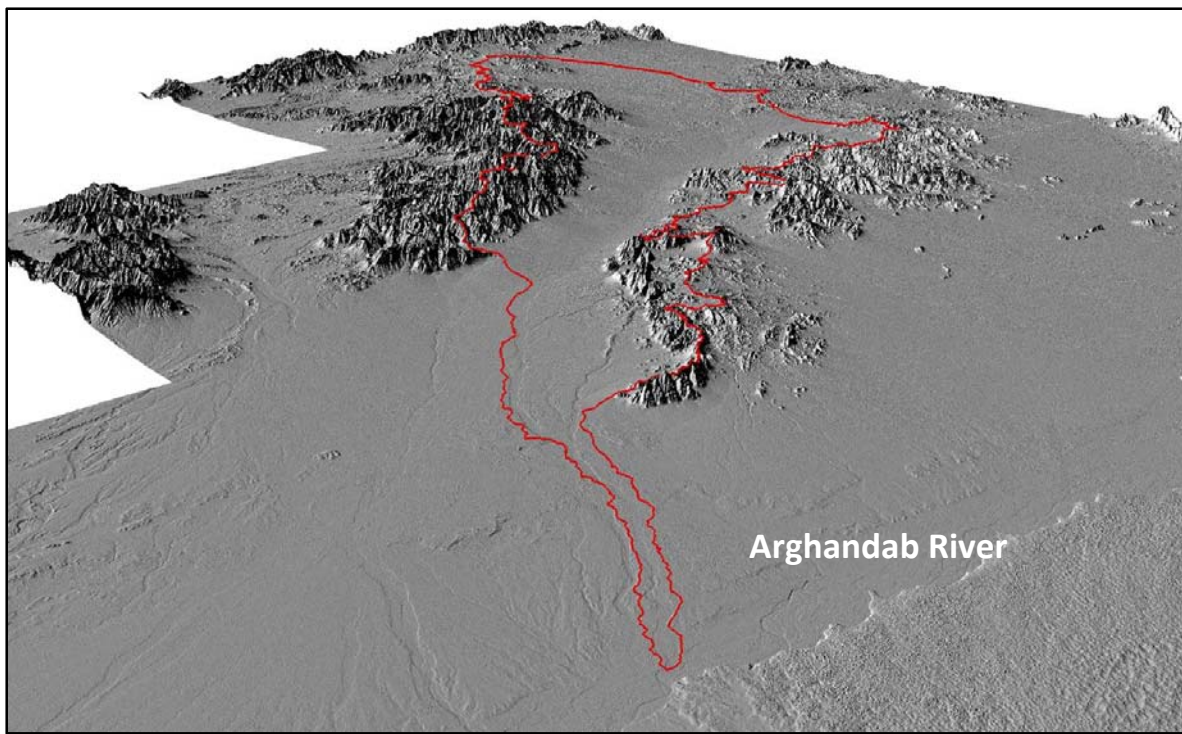


Figure 4.4. Delineation of the Pir Zadeh drainage basin employing the ArcMap hydrology tool set. The drainage basin boundary is draped on a hillshade DEM derived from IFSAR data. View is northeast.

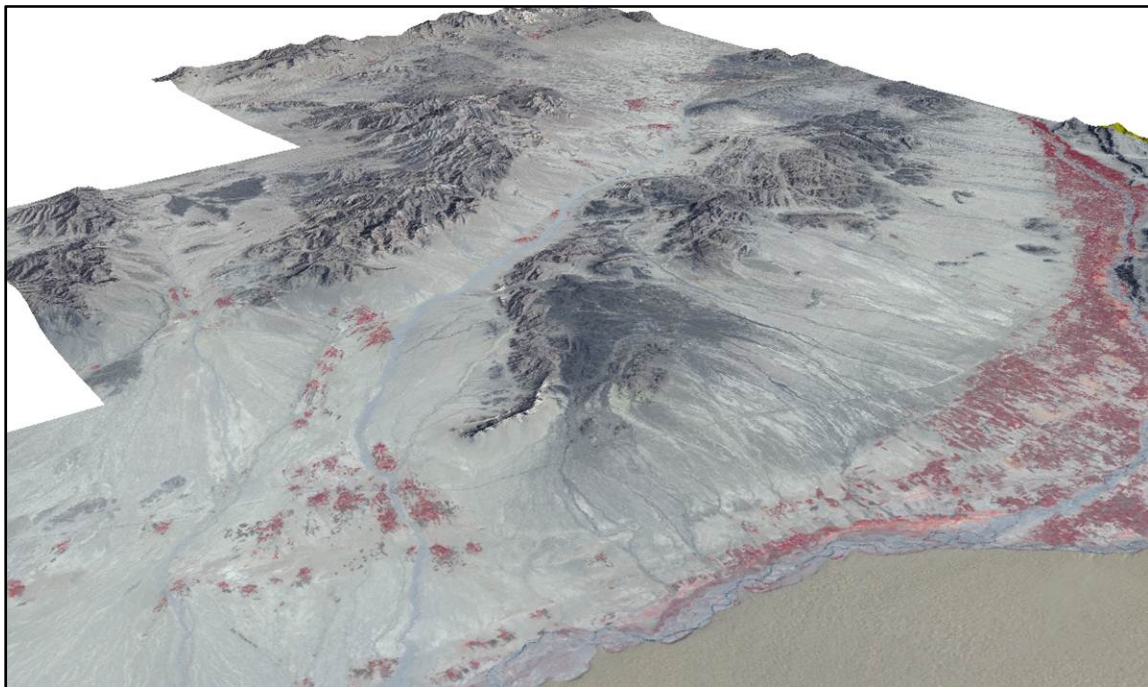


Figure 4.5. Irrigated growing season (NDVI) depicted on a Landsat image (July 2000) draped on an IFSAR-generated DEM (2006). Agricultural fields, illuminated in red, appear along the Arghandab River (right) and within the Pir Zadeh drainage basin.

## 4.2 Karez Mapping and Characterization Technology

Mapping of karez systems was conducted to evaluate the different approaches possible and to evaluate the viability of each and to document the relationship of these systems to the array of landforms, i.e., their geomorphic settings. The

anthropology component of this project has conducted low-resolution mapping of karez systems in two provinces. Karez mapping here is focused on high-resolution, detailed mapping of these systems in a single study drainage basin.

Since the underground conduit of the karez system is not directly detectable from imagery, we must rely on the distribution of the surface expression of chahs, or access shafts. Chahs consist of a vertical access shaft surrounded by the fill (spoil) extracted during construction of the shaft and portion of the conduit construction from a given shaft (Fig. 4.6).



*Figure 4.6. (UL) low-altitude view of chahs in southern Afghanistan, scale provided by vehicle tracks (image courtesy of Michael Yon); (UR) access shaft of a chah (USAID); (LL) view up a chah shaft during maintenance-rope attached to haul bucket (Iranian Public Television); (LR) interior of an operating karez conduit (Iranian Public Television).*

Recent inspection of karez systems in Israel provided first-hand exposure to the chahs and the subterranean conduit. The site visited, near Eilat, Israel, is a reconstruction of an ancient system, the conduit of which is accessed via one of two fortified chahs (Fig. 4.7).





*Figure 4.7. Karez in the area of Eilat, Israel. (T) interior of a dry karez conduit; (B) surface expression of abandoned chahs.*

In heavily utilized areas, i.e., those having an adequate flow for decades, centuries and perhaps millennia, have multiple generations of karez systems. As abandonment occurs, the shaft collapses or is backfilled and then the spoil pile encircling the former shaft begins to erode, likely through deflation, and gradually loses definition. The last vestiges detectable through remote sensing are donut-shape scars lacking sufficient elevation (sub-meter) to be detected with LiDAR data. Generations of karez, as manifest in the linear chah routes, are easily observable in Google Earth® where imagery is of highest quality (Fig. 4.8). Other artifactual features are frequently visible, e.g., canals abandoned due to channel flood damage or channel migration, abandoned fields, and building ruins.



*Figure 4.8. Surface expression of several generations of karez systems, as evidenced by variation in chah definition, condition, and cross-cutting relationships. (Google Earth® image)*

Those chahs which had apparently been isolated from the underlying karez conduit, i.e., no longer serving as an access or maintenance shaft, were colored coded. Figure 5.3, providing a vignette of a reach in the lower part of the study basin, defines the inactive chahs in red and the active chahs in green. For the entire study basin, nearly 40% of all chahs in close approximation to an active karez were nonfunctioning. The highest abandonment rates were located in the upper reaches of the basin, likely due in part to the character of the alluvium in which these karez were constructed. The alluvium is typically coarsest in the apex, or proximal part of the alluvial cone or apron thereby increasing instability within the shafts and conduits. No local testimony or information found in the literature addresses this difference in chah condition down through the basin.

Because karez are indicated by the tell-tale chah occurrence the surface, detection and mapping of these features was accomplished during the first phase using GIS hydrologic tools, specially designed algorithms (e.g, Trier & Pilo 2012), and differential comparison of return signals in the LiDAR data. Using this toolbox, the chahs were mapped and classified by condition. While the primary distinction made was that of a viable shaft (no collapse or infilling), the relative “freshness” of the chah morphology was documented. Specifically, chahs that reflect an abandoned karez or karez reach exhibit varying degrees of deterioration from wind and water erosion, and occasionally from use as a barrow site. Frequently, chahs will appear in closely-space parallel configurations, indicating the by-passing of failed segments of the karez conduit (Fig. 4.9).





*Figure 4.9: Segment of a karez where three generations of chahs indicated repeated failures of the conduit, requiring the lateral displacement of the system to by-pass the unusable portion. Note also that the surface drainage is at a near right angle to the karez alignment, which is not unusual given the relative independence of the surface water system from the ground-water system. (Image by W. Steele)*

Once the protocol for data acquisition from the Army Geospatial Center and the constraints on use and distribution of these data were resolved, derivatives such as hillshade digital elevation models and spectral images were produced, and techniques developed for kariz mapping and characterization and landscape analysis and mapping proceeded. The test location in Afghanistan is a same drainage basin designated PZ, after the small settlement of Pir Zadeh near the confluence with the Arghandab River (Fig. 4.10).

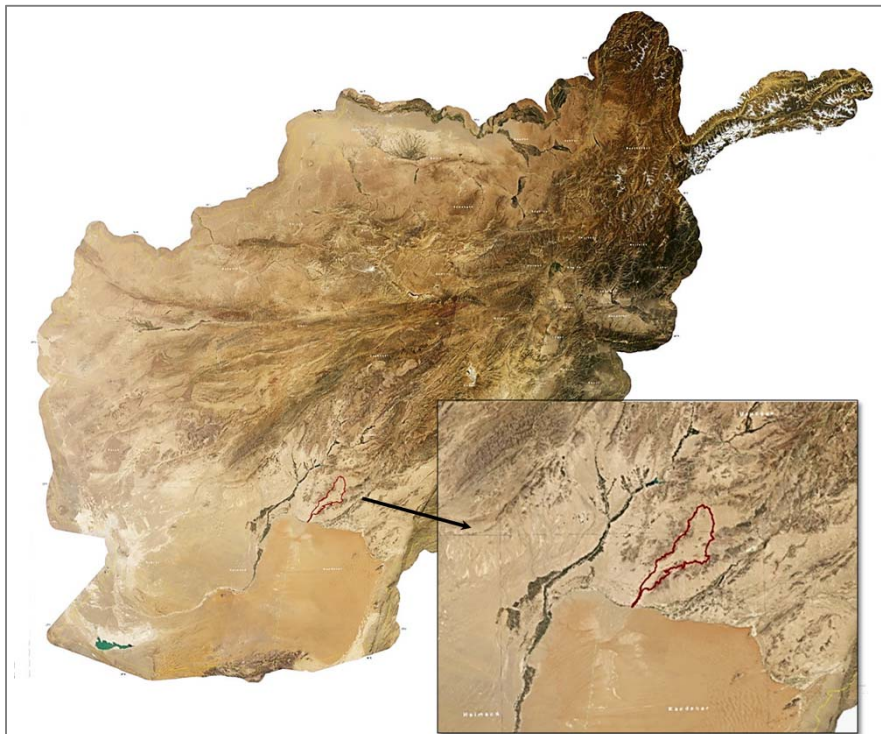




Figure 4.10: The Phase 1 and 2 study basin, which south into the Arghandab River.

The first and obvious data source for mapping chahs, canals, and fields associated with the karez systems is the Google Earth® imagery; however, the patchwork of imagery used is highly variable in quality and resolution, producing inconsistent detection and resulting distribution data. Despite incomplete LiDAR and orthophotography coverage for the Pir Zadeh basin, these imagery databases were used to develop protocols for chah development.

Chahs are being mapped with LiDAR data in two ways: first by using the GIS software hydrology fill tool to find depressions of chah access shaft size, and secondly by selecting the last return of the light pulse from the sensor, such as in Figure 4.9. By capturing and depicting the first LiDAR pulse return, positive features can be highlighted, which, in this relatively barren environment, are trees (structures excluded). Trees by and large occur along karez-fed canals encompassing fields (Fig. 4.11).

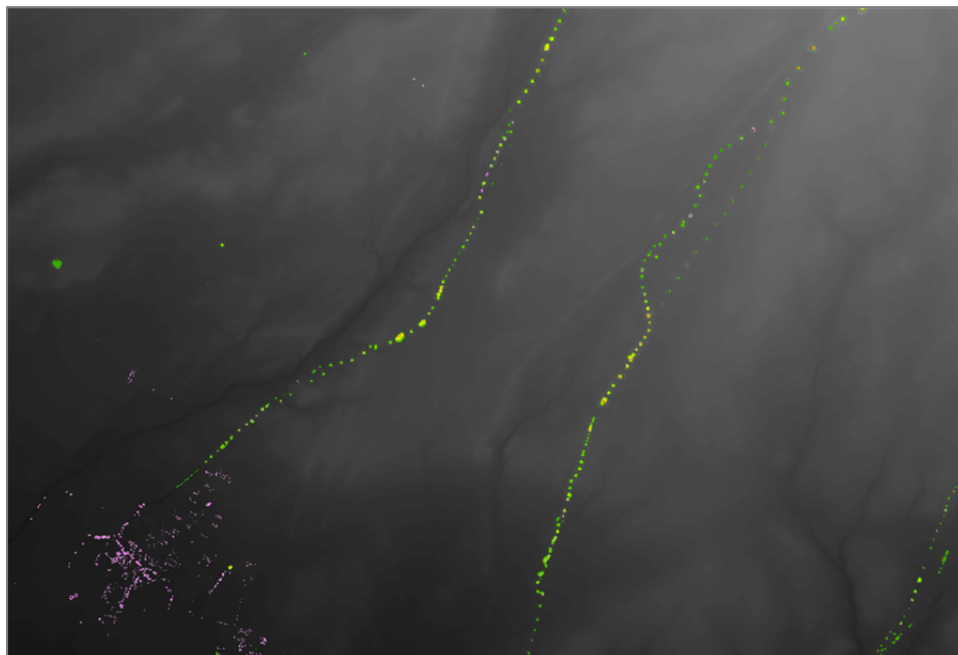


Figure 4.11. LiDAR returns illuminating both negative and positive landscape features associated with karez irrigation. Green-yellow colors represent the last return, i.e., the chah access shafts; whereas purple represents the first return, i.e., trees lining karez-fed canals and fields. The basemap is a DEM derived from the bare-ground LiDAR data.

Status of individual chahs was evaluated employing both orthophotography and LiDAR data. Planimetric chah attributes were determined with the orthophotography: location, spoil pile diameter, circularity, area, and diameter of access shaft. Routings of chahs (karez conduits) were also developed using GIS tools. LiDAR data were used to determine volume estimates of individual chah spoil piles and the condition of the access shaft, i.e., open, collapsed/filled, obstructed. Where chah access shafts are only a few meters deep, and perhaps collapsed, trees and shrubs often take up residence, or were perhaps planted or encouraged (Fig. 4.12). First and last LiDAR returns are useful in determining the presence of tree crowns within chahs, especially when it cannot be determined in the planimetric imagery if the dark area is a shaft shadow or a dark tree crown given that these trees appear to be broadleaf evergreens, i.e., no leaf-off observations possible (Fig. 4.13). Three, perhaps four generations of chahs are identifiable with both approaches. Some of the dark features in the prominent line of chahs are trees growing within the access shafts.

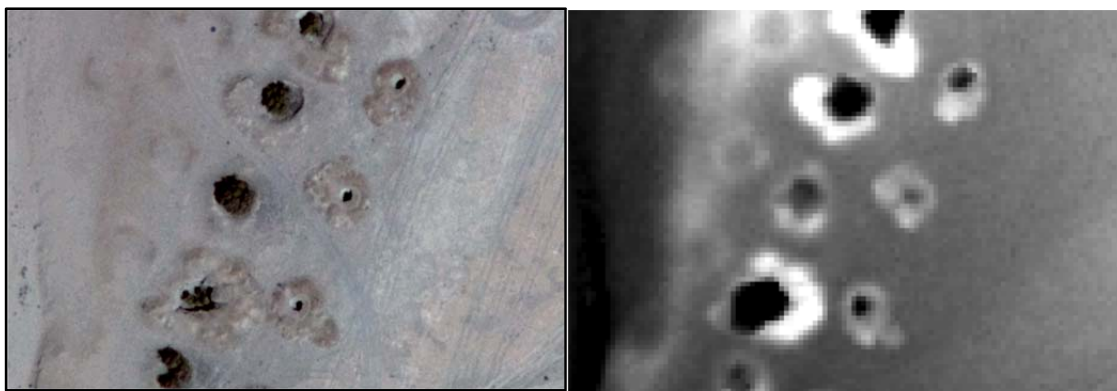


Figure 4.12. Detection of a series of chahs using 2-D orthophotography (left) and 3-D LiDAR data (right).

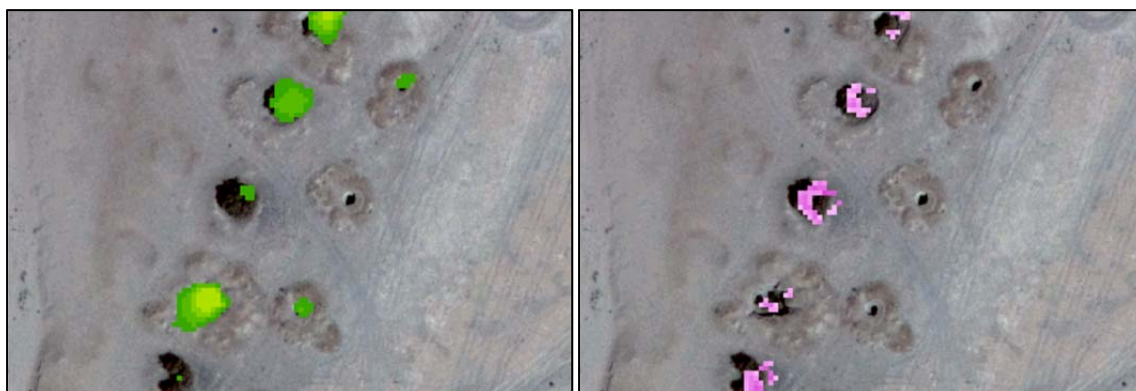
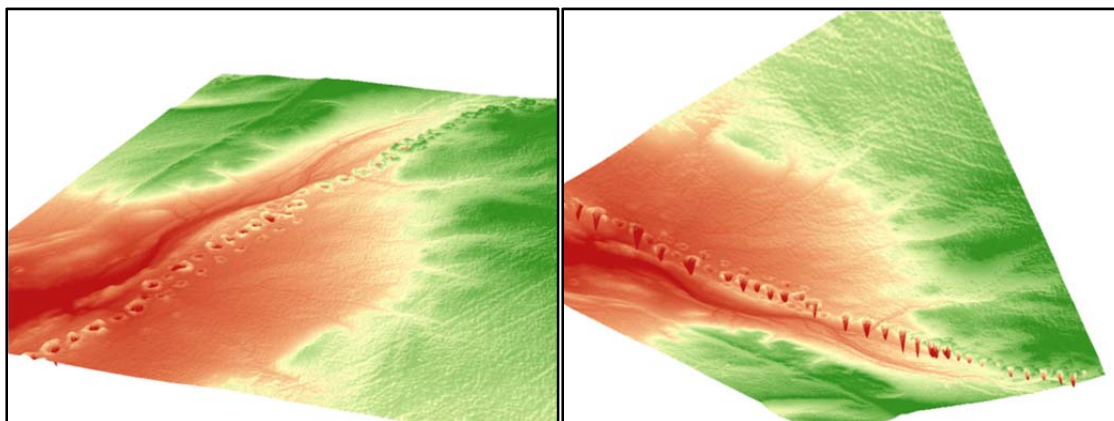


Figure 4.13. LiDAR-enhanced orthophotography. (L) Green-yellow color represents the last return, i.e., the open access shafts, and (R) purple represents the first return, i.e., crowns of tree growing within chahs.

Due to the X-Y density of LiDAR light pulses, chahs are usually penetrated to some depth, sometimes to the bottom, during data collection. Greatest depth penetrations then provide a minimum depth for the access shafts and therefore the depth of the subterranean conduit. Figure 3.12 (upper left) is a 3-D, LiDAR-generated DEM illustrating surface occurrence of chahs along a karez route, while the adjacent image (upper right) visualizes the subterranean penetration of the LiDAR pulses and minimum depths for the access shafts (Fig. 4.14-upper right). Another perspective is the 2-D rendering of chahs along the land-surface profile of the chah/karez route, e.g., the lower end of the Pir Zadeh drainage basin (Fig. 4.12-bottom). In this system, it appears that access shafts are at least 4-5 m deep and spoil piles 1.5-2 m high. Elsewhere in the basin, isolated chahs have produced LiDAR data indicating minimum depths of up to 15 m.



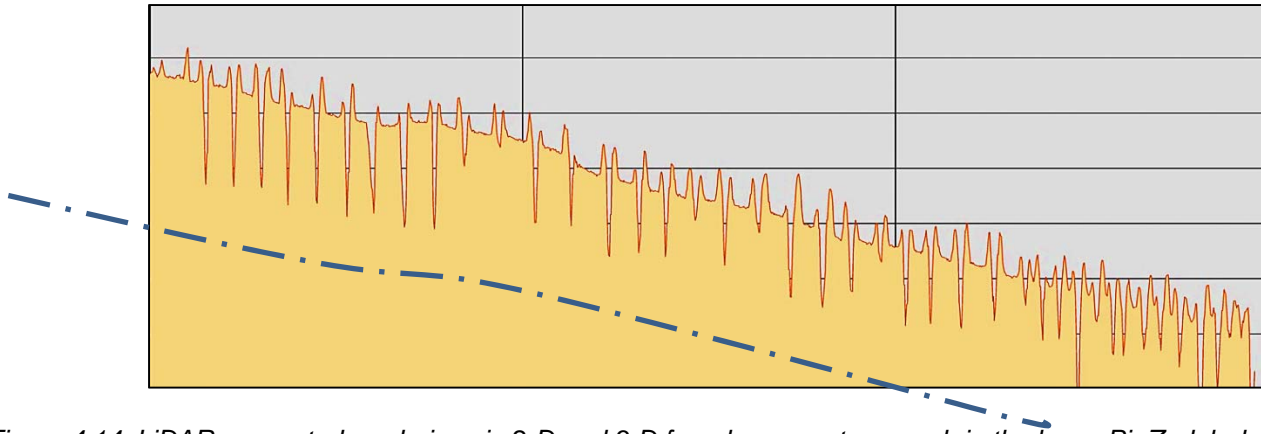


Figure 4.14. LiDAR-generated renderings in 2-D and 3-D for a karez system reach in the lower Pir Zadeh drainage basin. Upper panels represent colorized DEMs depicting the ground surface (L) and the sub-surface expression of the access shafts (R). The bottom panel is a profile of chaahs along a karez course. Minimum depth of the karez conduit is represented by the blue dashed line. The profile represents a 12-m drop in land surface over 1500 m horizontally.

A major issue in the process of modeling the distribution of viable and abandoned karez is accounting for the dramatic contrast in system expression in the upper basin compared to the lower basin. An important aspect of individual chaah and karez system study is that these features, being a reflection of 3-D groundwater distribution, are an entity often unrelated to the configuration of the land surface. For the upper Pir Zadeh and similar drainage basins in the region, this is readily apparent. Karez systems often cross from one surface drainage system to another, i.e., passing under drainage ways and drainage divides (Fig.4.15).

In the lower basin, karez are parallel to the major channels and actually developed within the floodplain or alluvial terrace system (Fig. 4.16). In the upper basin, however, the geologic materials transition from the relatively young (Holocene-historic) alluvium, which is only moderately cemented (carbonate) to the older (late Pleistocene—early Holocene) alluvium, which is more indurated. The increased level of induration (cementation) is evident in the pronounced dissection high drainage density of the upper basin. The nature of the material and landscape has, therefore, resulted in the development of upper basin karez such that their pattern has little relationship to the surface drainage. In many instances, the systems flow beneath surface drainage divides. While the drop in surface elevation averages ~21 m for a given karez run for both the upper and lower basin areas, karez are much shorter in the upper basin (~1400 m vs. ~2700 m) due to the steeper surface slope and steeper dip of the water-bearing sand and gravel layers and of the water table (Fig. 4.17).

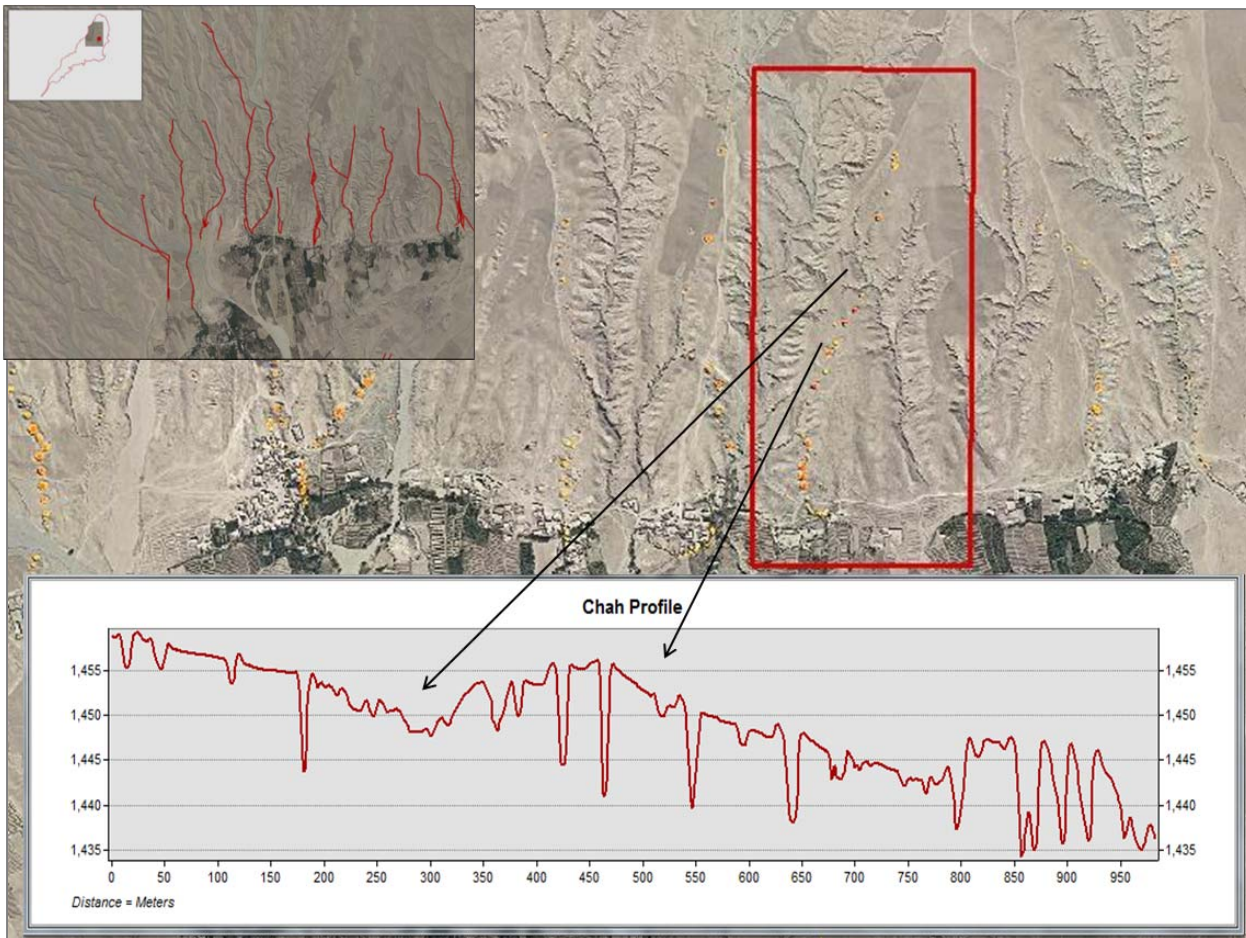
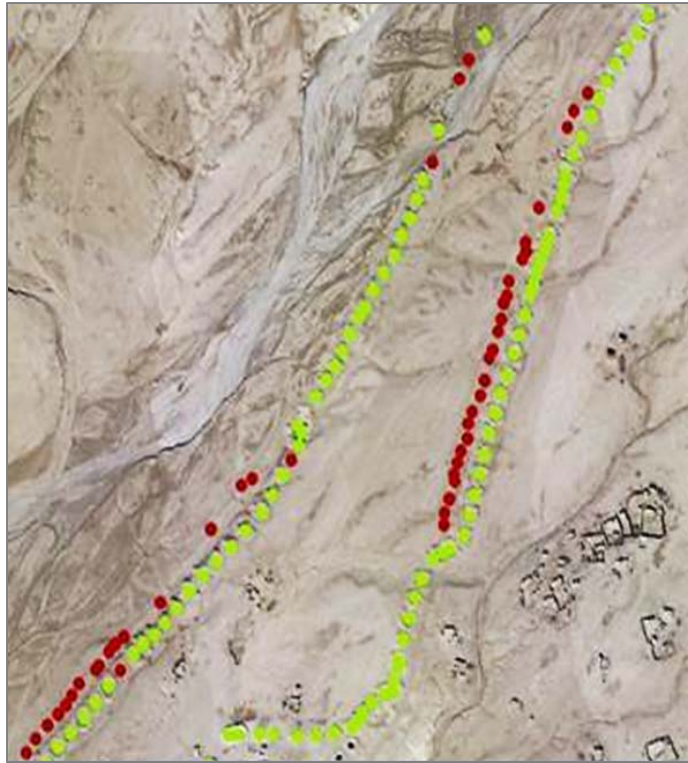


Figure 4.15. Routes of karez systems within the middle to upper part of the Pir Zadeh drainage basin (upper left insets), and a landscape surface profile illustrating a karez system that runs beneath drainages and drainage divides. Yellow-orange colors on the image indicate chahs.





*Figure 4.16: Chahs mapped within a portion of the lower study basin, where open and presumably viable chahs are indicated in green and those no longer open shafts in red. The parallel pattern of red to green symbols suggests bypassing of failed system segments.*

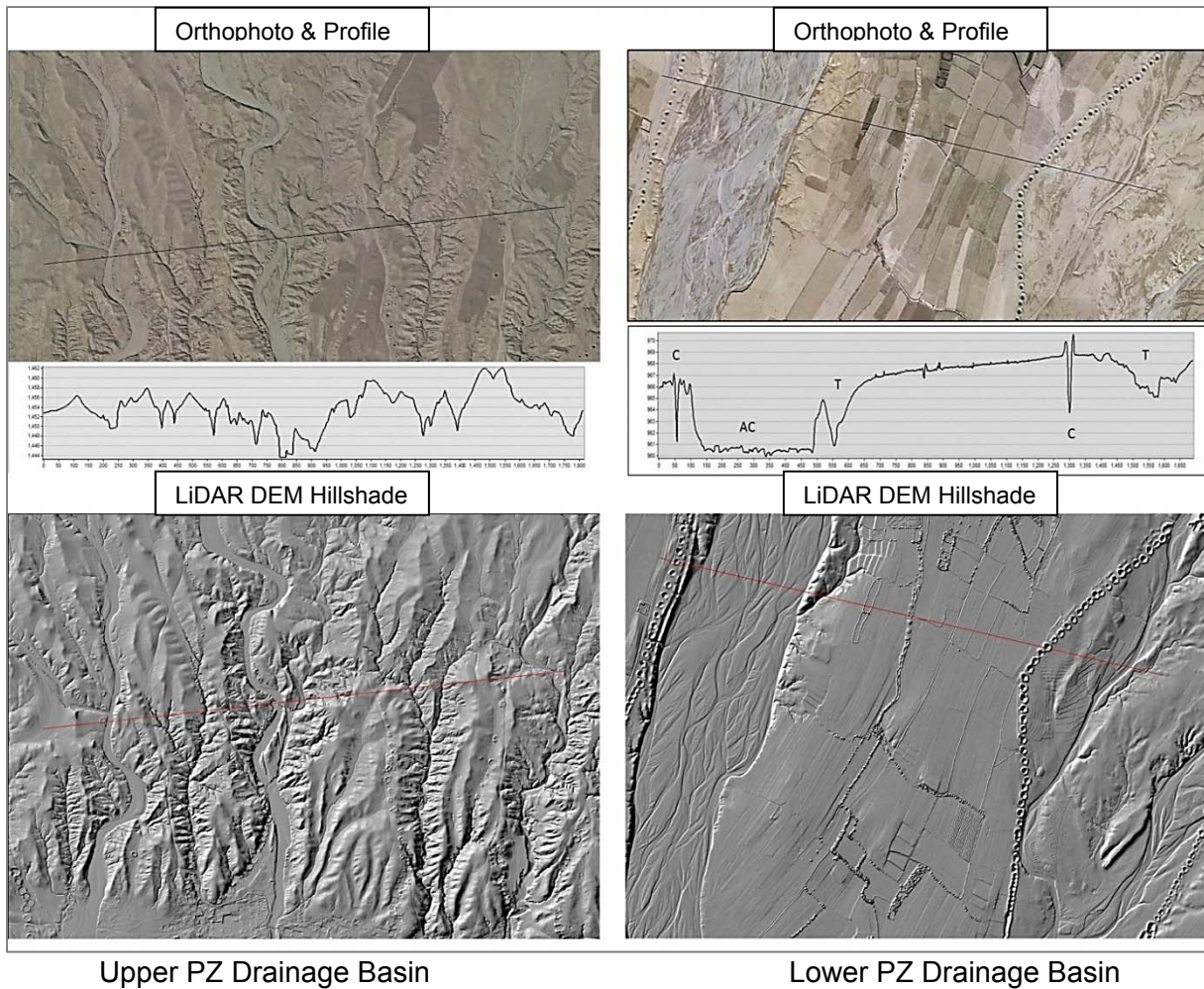
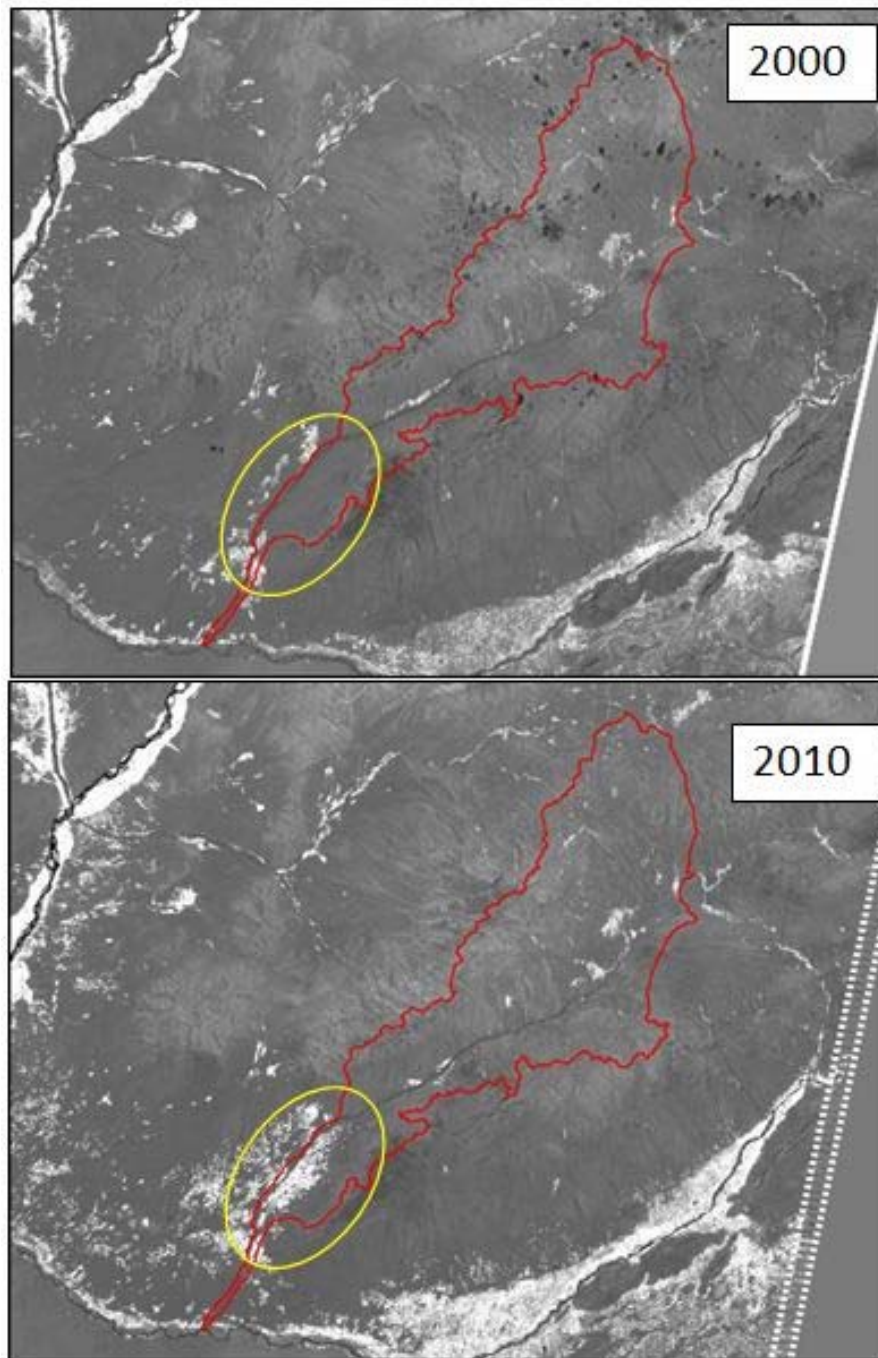


Figure 4.17: Representations of the upper and lower PZ study drainage basin. Top row consists of orthophotographic images with companion land-surface profiles derived from the transect line. Lower row images are hillshade DEMs created from the LiDAR data. Whereas karez follow the channel way in the lower basin, their pattern is largely independent of the surface drainage in the upper basin.

### 4.3 Climatic Variability and Landscape Response

In recent decades, Afghanistan has experienced severe drought conditions, particularly 1998-2003, 2006, and 2008. Though southern Afghanistan rainfall has decreased, snowpack in the Hindu Kush has also undergone dramatic decreases. These short-term variations in climate have profound cultural impacts, but produce changes in the natural landscape as well, an example of which is apparent channel entrenchment in the lower Pir Zadeh drainage basin. Coherent proxy records of past climate are lacking in the region, but past shifts in precipitation are evidenced by alternating development and abandonment of prehistoric irrigation canal systems within the Sistan depression, termination of the Helmand River and located about 300 km southwest of the study area. Canals were in use 1300 BC to 750 BC, 200 BC to AD 400, and most recently AD 800 to AD 1550, intervals presumed to be periods of increased precipitation (USGS Sci. Inv. Rpt. 2006-5182). These periods related to global climate episodes, e.g., the most recent period coincides with the Medieval Climatic Anomaly (aka Medieval Warm Period).

Landsat NDVI data illustrate effects of recent drought conditions on available irrigation waters. A comparison of NDVI data between the years 2000 (dry year) and 2010 (average year) documents major differences in growing season irrigated lands (Fig. 4.18). Within the lower Pir Zadeh basin, a large area of irrigated land was not in production during 2000.



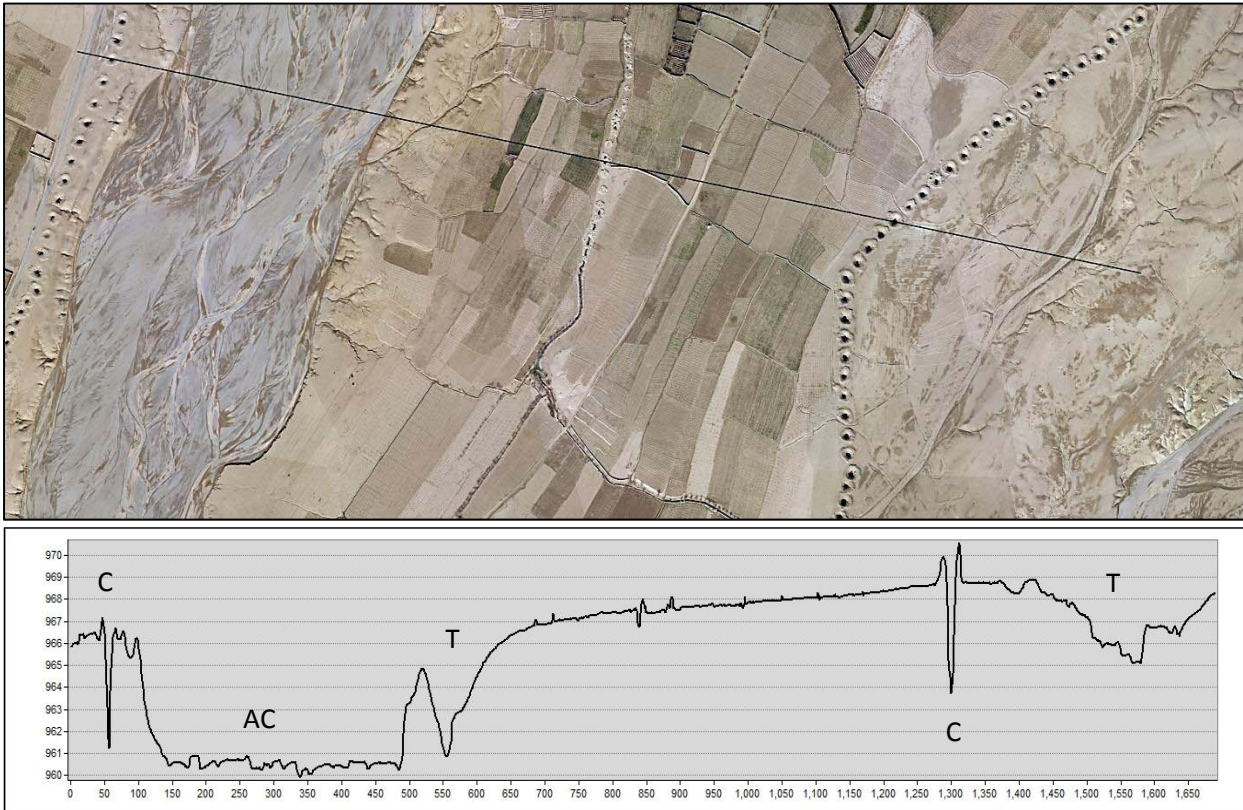
*Figure 4.18. Landsat NDVI images for 2000 (dry year) and 2010 (average year). Though differences in crop production (irrigated land) are relatively small in the Helmand River valley (upper left of images), obvious differences are evident within the Pir Zadeh basin, as well as the east in the Kandahar area within the Arghandab River valley. Areas within the yellow ovals provide an example of the difference.*

#### **4.4 Landform Analysis and Mapping**

After considerable manipulation of available imagery and maps, a detailed geomorphic map of the Pir Zadeh drainage basin is being created. A 2-D profile generated along a cross section of the main channel area of the lower end of the basin illustrates the channel proximal geomorphology (Fig. 4.19). The transect crosses three karez systems: a relatively large system to the east, a small one in the center, and another at the west end of the transect, adjacent to the channel. The active braided channel bed is 7-8 m below the adjacent alluvial surfaces; channel entrenchment occurred in this reach, perhaps in the early to middle Holocene. Mid-channel bars are discernible across the 400 m-wide channel. LiDAR



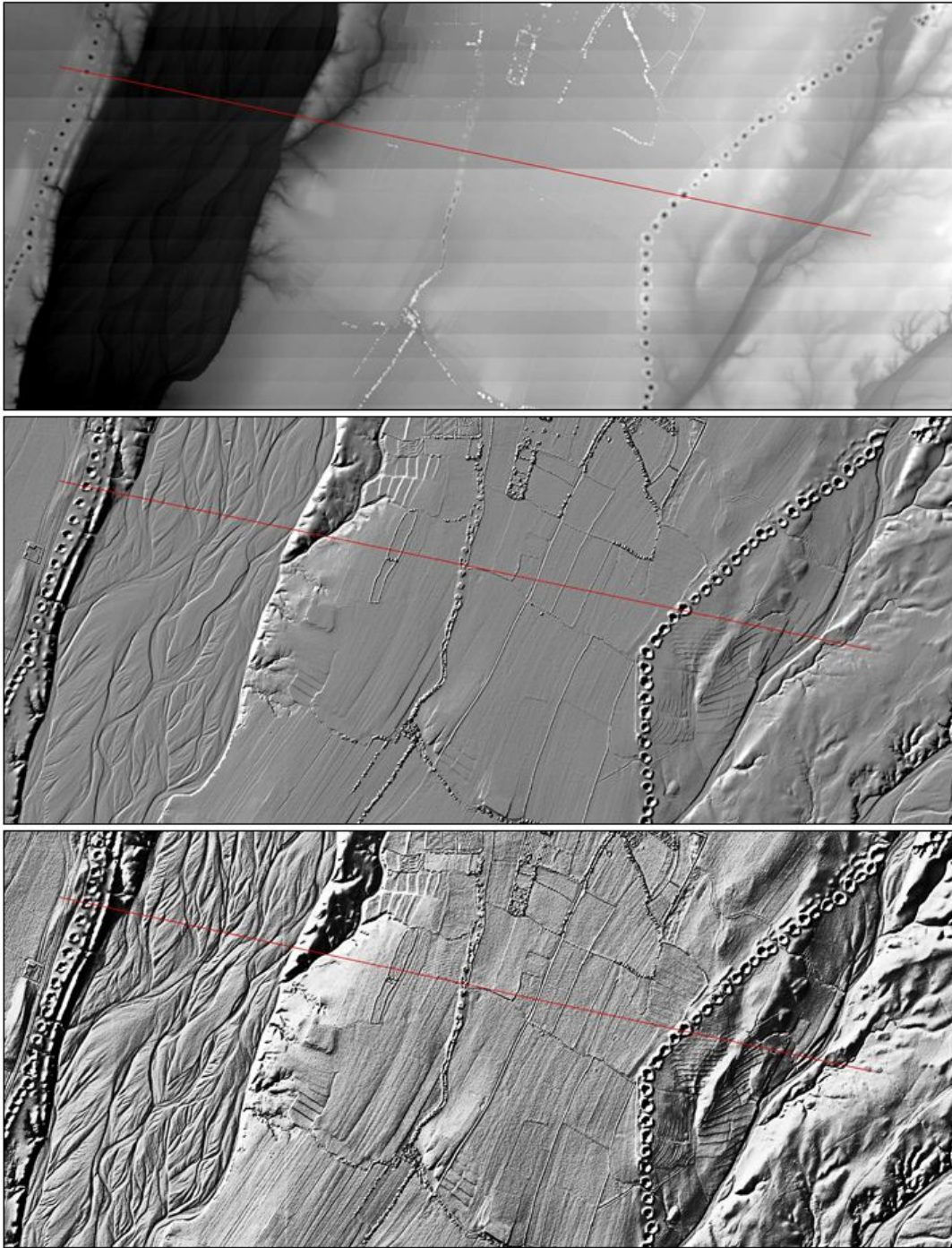
pulses reveal at least part of the access channel depth; actual depth to the conduit is likely several more meters because the water table most certainly lies beneath the channel. The elevated surface on the west side of the channel is low terrace, and the expanse on the east side is high terrace.



*Figure 4.19. Location of one of a series of transects along which profiles are being generated in the process of mapping the Pir Zadeh channel system, depicted on orthophotography (top). The active braided stream channel, as well as three karez systems, are included in the transect. The profile (bottom), generated from LiDAR data along the transect, images various features, e.g., two chahs (C), mid-channel bars within the active channel (AC), and tributary channels (T).*

Elevation (z) data provided by LiDAR, essential for high-resolution landform mapping, may be rendered in a multitude of ways, three of which are illustrated in Figure 4.20. These three rendering were constructed through selective use of data from the histogram of data for the scene.





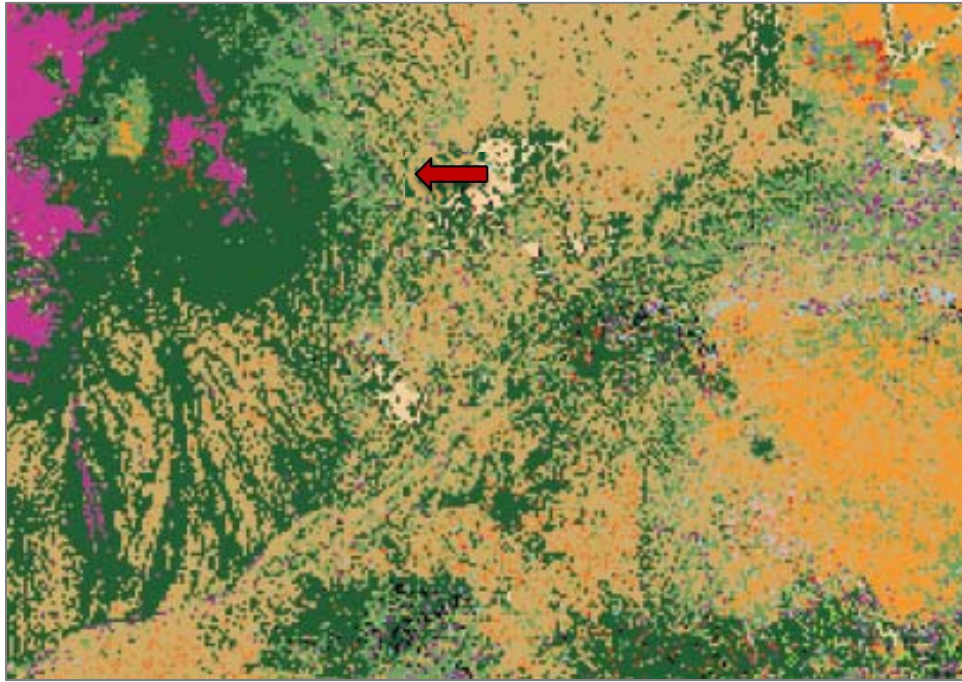
*Figure 4.20. Rendering options of LiDAR data constructed through manipulation of the data histogram from the scene. Top rendering is of the first return using 2 standard deviations (center) of the data histogram for visualization; Middle rendering is a hillshade of the top rendering; Bottom rendering uses histogram equalization, which emphasizes the histogram tails to provide more detail.*

First is a representation of the center of the histogram (2 sd), which provides a scene accentuating features that “pop” from the surrounding area (e.g., chahs, river channel). Another sample rendering is that of creating a hillshade DEM, here with an illumination from the northwest. The third rendering is a hillshade that includes the information in the tails of the histogram (histogram equalization) to bring out minute detail, such as the braided channel bed. Each different rendering has its role in providing unique information for landform mapping and modeling.

#### **4.5 Geochemical Characterization of the landscape**

This facet of the inquiry is focused on the use of readily available multispectral data from satellite sensors for the geochemical characterization of the land surface in the PZ study basin. Such data provide insight into landscape evolution and landform development, and cultural impact on the landscape (e.g., Cranfield et al. 2004; Tajgardan et al. 2010).

Hyperspectral data have also been acquired for Afghanistan from a NASA aircraft as part of the USGS program to evaluate mineral resources of the country. Two hyperspectral surface materials maps recently released by the USGS include one depicting carbonates, phyllosilicates, sulfates, altered minerals and other minerals and materials (Kokaly et al. 2011) and another depicting iron-bearing minerals (King et al. 2011). Though the latter indicates much of the study basin as “unclassified,” the former does show patterns consistency with the geology, land-surface processes, and cultural utilization of the landscape (Fig. 4.21).



*Figure 4.21: The above image, clipped from the USGS hyperspectral surface material map of carbonates, phyllosilicates, sulfates, altered minerals, etc. Colors represent the following: purple-dolomite, green-calcite, medium tan-calcite & montmorillonite, light tan-green vegetation, and orange-muscovite. The arrow indicates an irrigated field area and settlement shown in Figures 4.22-4.24. (from USGS Scientific Investigations Map 3152-A by Kokaly et al. 2011)*

Given the availability of multispectral data from at least two satellite platforms (Landsat, ASTER), images visualizing results of spectral-band blending and ratioing are being used to display the distribution of soil constituents. Though Landsat is more limited than ASTER due to differences in band width, Landsat can be used to sense soil properties, as it does with degrees of vegetation vigor (NDVI). In an effort to extract data more relevant to the goals of this investigation, multispectral data from Landsat and ASTER sensors, onboard the TERRA satellite, have been used, with basin-wide mapping and classification currently underway. ASTER spectral data were used in various ratios to determine the distribution of different surface constituents. For example, carbonate (calcite) is sensed using the band ratio 13/14, ferric iron the ratio 2/1, and clay the formula  $(5 \times 7)/6^2$ . Figure 4.22 illustrates the distribution of insoluble ferric iron ( $\text{Fe}^{3+}$ ). The concentration of ferric iron in the cultivated fields is obvious; irrigation water has deposited the iron, producing the concentration. This approach is somewhat useful in detecting abandoned ancient fields which were irrigated. Stream beds show high concentrations as well because of the higher density of iron-bearing bed-load accumulations. High concentrations also occur along the periphery of the basin, but these are a result of the bedrock, primarily dolomites, with some igneous intrusions.



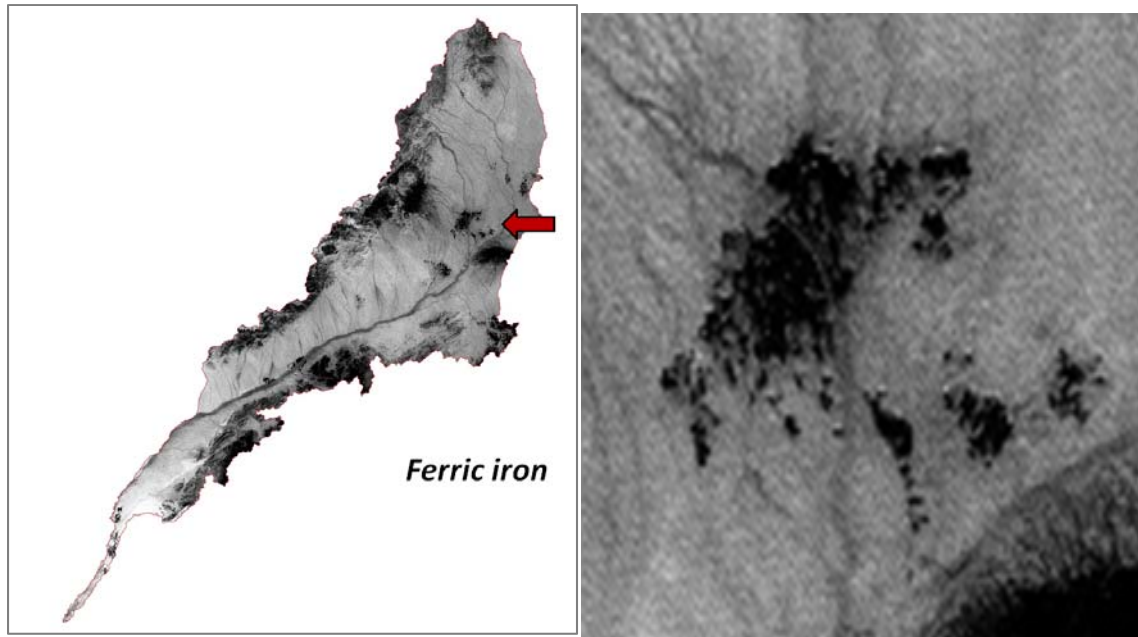


Figure 4.22: Gray-scale rendering of ASTER-derived band ratio data sensitive to ferric iron ( $\text{Fe}^{3+}$ ) for the PZ basin (L). The close view of the agricultural area (arrow) shows the well-defined concentration associated with the irrigation using water from karez systems to the north (R).

ASTER spectral band data were also employed to determine the distribution of areas with relatively high salt concentrations (Fig. 4.23). The high soil surface salinity results from the precipitation of the salts as the evapotranspiration process. This metric has proven extremely useful in defining irrigated fields, but has been less robust than the ferric iron indicator of abandoned fields, likely due to the re-dissolution of the salt by runoff and infiltration from the rare rainfall events.

A third example of spectral rendering of land surface material is that of clay concentration. Referencing the same agricultural area in the upper part of the PZ basin, clay concentrations were, as with the previous metrics, relatively high (Fig. 4.24). Data from two different years were used to compensate for the range of soil moisture, i.e., availability of karez water. Confinement of the areas with detectable surface clay concentrations to the agricultural areas is consistent with long-term agricultural use, which has modified the soil texture.

This was anticipated as well due to multiple factors. Being the finest of the clastic sediment load, the clays are carried in suspension by the karez water and deposited on the fields. Another mechanism likely responsible for the elevated clay levels is wind deposition, by the northerly winter winds and the southwesterly winds during summer. MODIS and SeaWiFS images of dust plume transport suggest dust transport from the Sistan Basin across the Registan Desert and north toward the PZ basin. An additional source of the clay could be pedogenic, i.e., secondary clay production due to soil forming processes operating in the agricultural fields, though this probably minimal. Areas of highest concentrations are indicated in Figure 4.24 by colored pixels. Distribution of these locations is not all that clear, seemingly almost random. The only visual correlation observed is that most, but not all, of these same areas produce higher NDVI values, indicating more crop vigor. Certainly more inquiry is needed to decipher the patterns of these pixels, if indeed they are real.

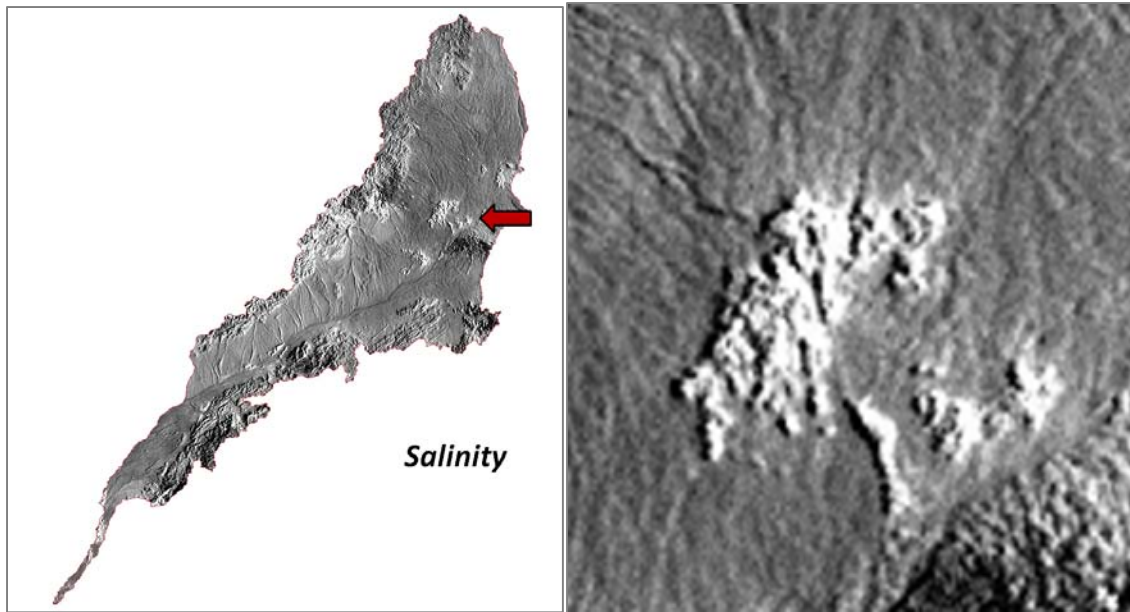


Figure 4.23: Gray-scale rendering of Aster-derived band ratio data sensitive to soil surface salinity for the PZ basin (L). The close view of the agricultural area (arrow) shows the well-defined high soil surface salinity associated with irrigation (R).

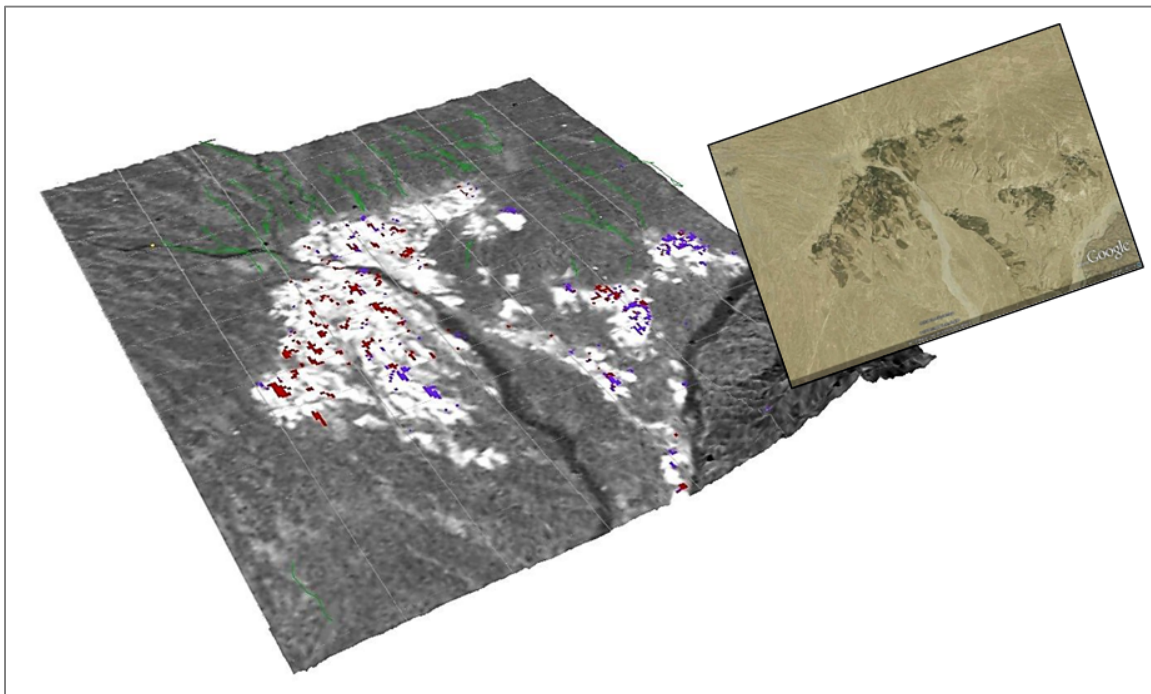
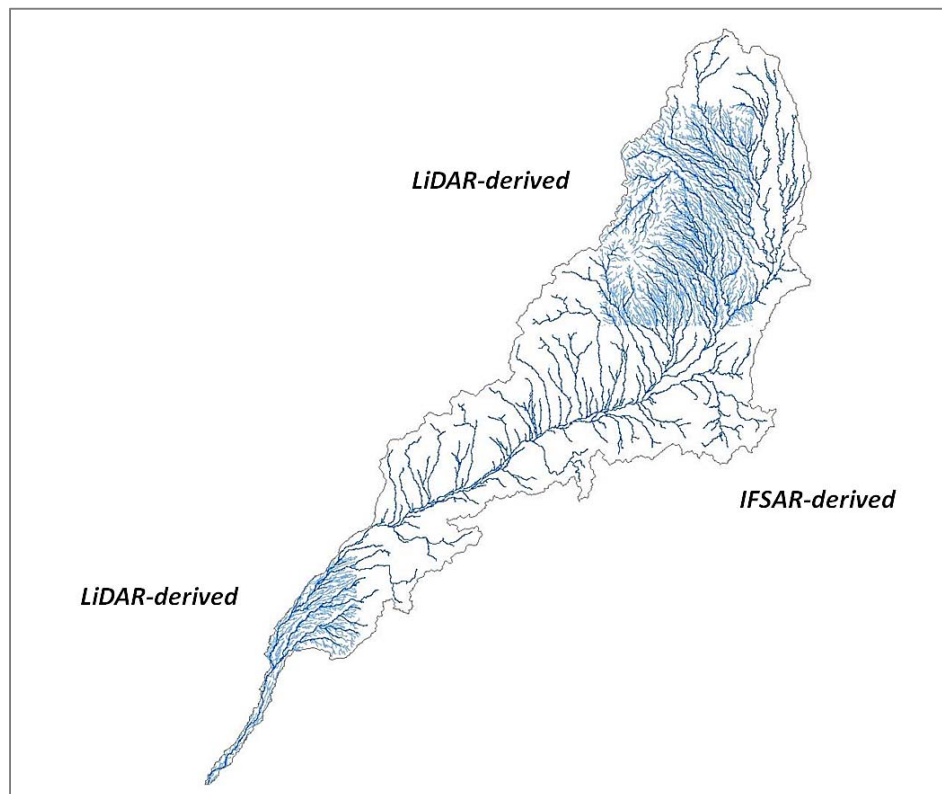


Figure 4.24. Spectral proxy for soil-surface clay content. Landsat spectral data draped on the LiDAR DEM for the karez-supported agricultural area in the middle of the Pir Zadeh drainage basin, with the corresponding Google® image (low-resolution SPOT) Landsat image for reference. Spectral data depicted include the NDVI response (white areas indicating karez-supported agriculture); green lines show karez system routes. Blue pixels represent the band 5:7 ratio for 2000, a dry year, and red pixels the 5:7 ratio for 2010, a year of average precipitation.

#### 4.6 Surface-Water Hydrology--Drainage Networks and Water Flow Paths

Developing models dealing with surface-water hydrology have only recently been initiated for this study. The initial steps include the derivation of the drainage network and related landscape characteristics related to surface runoff. Because the

high-resolution LiDAR data do not exist for the entire PZ basin (Fig. 4.25), IFSAR drainage network and landscape attribute data will be used, which will also greatly reduce computing time. For select sub-basins from within those areas where LiDAR data exist, model scenarios will be run for comparison with results from the IFSAR-derived network.



*Figure 4.25: Drainage system development in the PZ drainage basin developed using ArcGIS tools. The drainage network for the entire basin was constructed using IFSAR data, with a resolution of about 11 m. In the two areas where the higher resolution (~1 m) LiDAR data were available (upper and lower basin), drainage density is much greater than with IFSAR data.*

In a fashion similar to that of the drainage network, surface-water flow paths were determined for the PZ basin using both IFSAR and, where available, LiDAR data (Fig. 4.26). The asymmetry of the PZ basin becomes very apparent in this depiction of basin morphology, and provides a textbook example of the role of tectonics in drainage basin formation.

This section and that which follows are focused on surface-water hydrology and the results of potential catastrophic flooding. Baseline data are being generated for application of hydrologic model. At this time, the modeling has not been started, but this work will take advantage of the software available through the US Army Corps of Engineers technical support from colleagues at the USACE WES. They offer various models, including HEC-HMS (successor to the HEC-1) and more recently the HEC-RAS. The USGS offers models as well, which will be evaluated with the assistance of colleagues at the Water Resources Division office in Lawrence, KS. In the course of conducting this modeling exercise, the new version of ArcGIS Arc Hydro Tools will be employed.

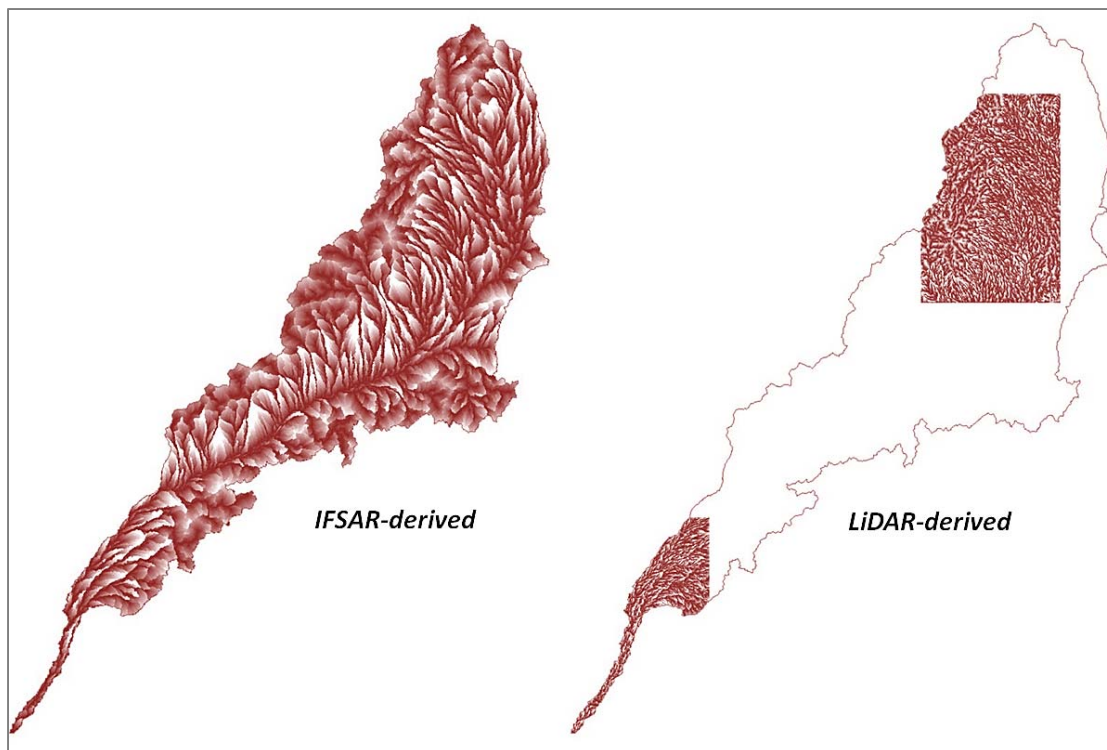


Figure 4.26: Flow path determination for the PZ drainage basin developed using ArcGIS tools. This is a representation of the various surfaces contributing water to the drainage systems. As in Figure 5.9, the results using the lower-resolution IFSAR data are compared to that using higher-resolution LiDAR data.

#### 4.7 Flood-Water Depth Scenarios

Water-stressed regions do have extreme flood events, as recent history has shown, which necessitates planning for not only extreme drought but also for catastrophic flood events. Afghanistan has seen horrific flooding in recent years (Fig. 4.27). For example, in the first week of February 2013, heavy precipitation (rain and snow) fell on most of the country, but mainly the central and western regions. This event resulted in extensive damage to buildings and infrastructure, with ten people dead and over 1200 families displaced.

Flood-water inundation estimation using available satellite imagery can be accomplished remotely, thereby providing a means to reduce the impact of such flood events by improving shared situational awareness during major flood events. Timely acquisition of appropriate imagery for flood extent estimation, however, is often complicated by satellite orbital considerations, weather, cost, data licensing restrictions, and other issues. Recognizing the need to develop tools to supplement imagery where not available, complement imagery when it is available, and bridge the gap between imagery based flood mapping and traditional hydrodynamic modeling approaches, Researchers at the Kansas Biological Survey and Kansas Remote Sensing Program have developed a topographic floodplain model (FLDPLN) that has been used to identify and map river valley floodplains using elevation data ranging from 90-m SRTM to 1-m LiDAR. Resulting floodplain “depth to flood” (DTF) databases are completely seamless and modular. Consequently, FLDPLN can be used for river valley identification, flood estimation, hydrologic connectivity indexing, and scenario modeling (e.g., a particular flood event or impacts of adding or removing levees or other structures). Model outputs have applications for river valley morphology assessment, archaeological explorations, ecological modeling, wetland identification and delineation, and flood disaster response mitigation and damage assessment. Elevation data used in this application of FLDPLN included high-resolution, drone-acquired LiDAR (1 m) and IFSAR (5m; INTERMAP). Results provide a quantitative approach to evaluating the potential risk to urban/village infrastructure as well as to irrigation systems, agricultural fields and archaeological sites.

This approach was applied to the lower PZ basin and the Arghandab River in the PZ confluence reach (Fig. 4.28). FLDPLN was run using the IFSAR 11 m resolution DEM. Two flood-depth scenarios were run—5 m depth and 10 m depth—for the Arghandab River reach, eastern PZ tributary, western PZ tributary, and combined eastern and western



tributaries and Arghandab channel (Fig. 4.29). These models indicate the potential for widespread flooding in an area heavily populated, intensely agriculture and crossing the route of a major highway.



Figure 4.27.. Flooding in Afghanistan, July 2010. (Left-Militarytimes.com; Right-DOD)

Water-stressed regions do have extreme flood events, as recent history has shown, which necessitates planning for not only extreme drought but also for catastrophic flood events. Accordingly, FLDPLN is being applied to channel systems in Afghanistan. This research activity has only begun in this phase, but that which has been accomplished focused on the PZ drainage basin and its parent stream the Arghandab River. Using low-resolution data, the model was run for the Arghandab River main channel, starting above the Arghandab Dam and reservoir to its confluence with the Helmand River (Fig. 4.28). Limited lateral extent of the flood waters is indicative of entrenchment of the channel, e.g., below the dam and in the upper part of the PZ basin. However, given the broad, low-slope confluence area, the lower end of the PZ drainage suffers substantial inundation, including the dense settlement and agriculture along the highway.

Results provide a quantitative approach to evaluating the potential risk to urban/village infrastructure as well as to irrigation systems, agricultural fields and archaeological sites. Any number of flood-water depth scenarios can be presented, but this rendering provides a vision of a truly catastrophic event, one similar to that which occurred in the late 1800s.

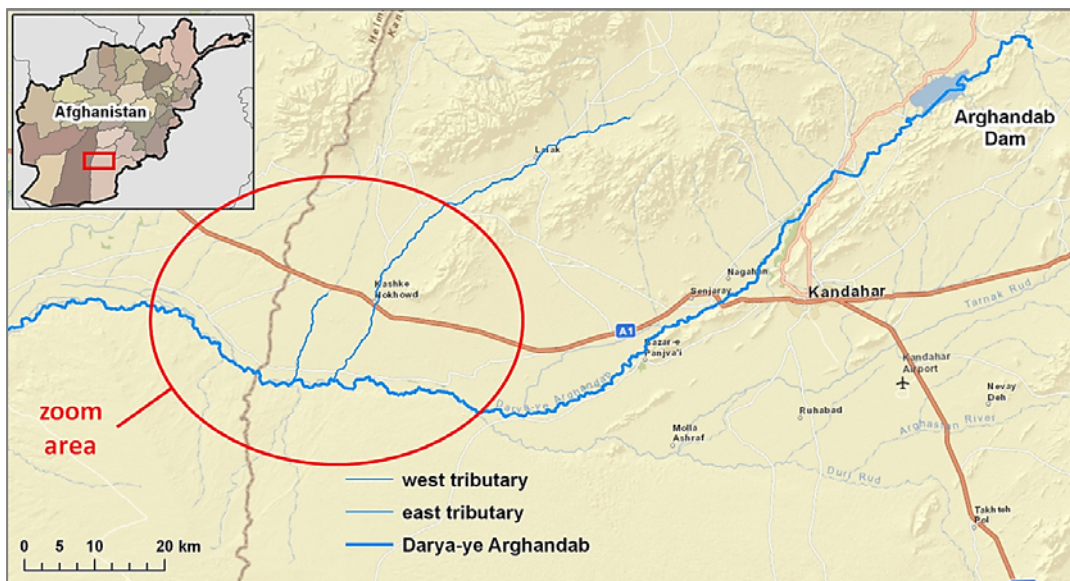


Figure 4.28: The PZ basin draining southwest into the Arghandab River, with the area of the flood modeling indicated.



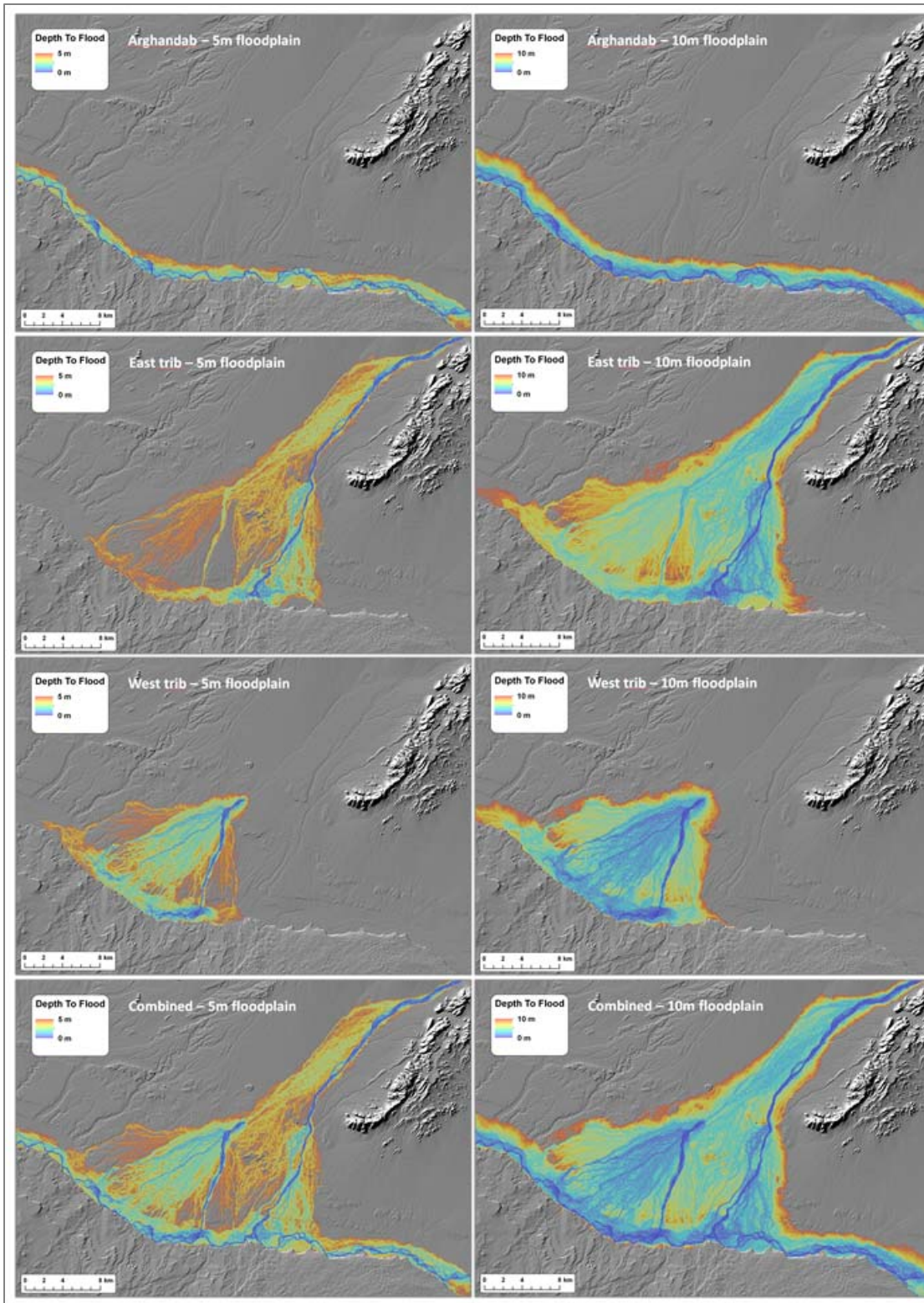


Figure 4.29: Confluence area of the PZ basin with the Arghandab River (zoom area in Fig. 4.28) with flood-depth scenarios developed using FLDPLN. Five and ten m flood-depth scenarios for the Arghandab River and east and west distributaries of the PZ basin drainage system.

## 4.8 Summary

As part of Phase One Thrust six, these investigations were seamlessly merged year to year, with the objectives of this investigation including development of relatively fast and efficient protocols using remotely sensed data for (1) mapping and evaluating karez systems; (2) spectrally detecting surface variations in geochemical and physical constituents; (3)

deriving drainage patterns and surface-water flow patterns; and (4) adapting and testing a recently-developed flood inundation model. All these goals have application to military operations, be they engagement of hostiles, protection of water-acquisition systems, or preservation of cultural antiquities.

Phase Two is focusing on the application and subsequent refinement of these protocols to the basin and country scale.

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## II. AGS-KU Bowman Expedition to the Borderlands Region

Jerome Dobson, Ph.D.  
University of Kansas

**Summary.** The **American Geographical Society's Bowman Expeditions Program** provides a framework for gathering human geography data through fieldwork in foreign areas. It aims at revitalizing world human-regional geography as a vital component of our understandings of peoples and places around the globe. The AGS Bowman Expedition to the U.S. Borderlands is producing an improved multi-scale GIS for the region and new fine-resolution human geography data on property and ethnicity for key areas within the region.

Results from the Borderland Expedition, including the GIS and associated database, while still under development, have already supported applications for both indigenous land titling and biosphere reserve conservation initiatives in Honduras, attesting to its enormous practical and scholarly potential. The research team also recently won the prestigious DoD

Minerva Initiative Grant for University-led research. We summarize briefly here project results that are detailed in earlier project reports prepared for the ARO over the duration of the project.

**Background.** The University of Kansas has partnered with the American Geographical Society (AGS) to develop the **AGS Bowman Expeditions Program** as a university-based approach for addressing the need for better understandings of foreign cultures that is grounded in fine-grained, place-based GIS research. Different from the controversial U.S. Army's Human Terrain System (HTS), the Bowman Expeditions Program offers a **pro-active, non-military, university-based, scholar-student approach for producing vital, open-**





**source human geographic information** (overview article, see Herlihy et al. 2008). With modern methods and automated information technologies, it produces vital, open-source information that results in better mapping, analyses, and GIS functionality for subsequent users. While critics discourse on the potential dangers of military funding in geographic research (see Herlihy 2010), since 2005, Bowman Expedition teams have successfully completed research in Mexico, Colombia, the Antilles Region, Jordan, and Kazakhstan.

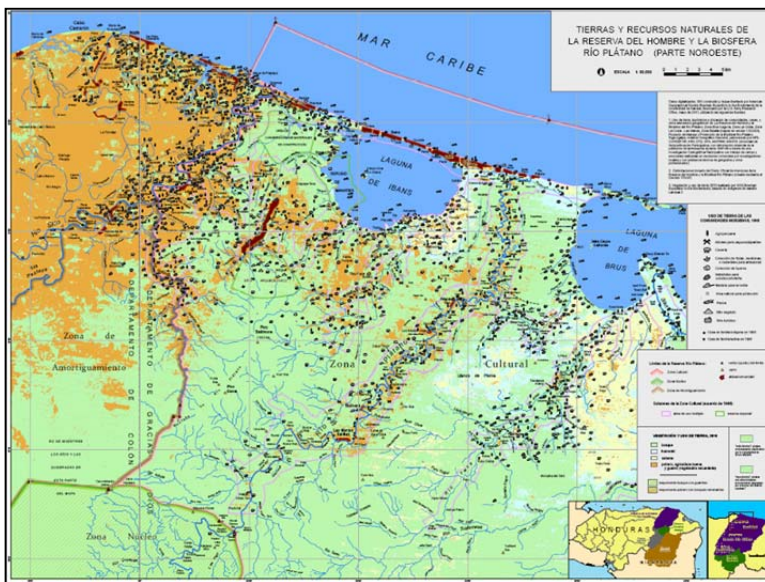
**Bowman Expedition to the U.S. Borderlands.** In June 2010, a KU-AGS Bowman Expedition to the U.S. Borderlands began **developing an open-source, multi-scale GIS platform on property regimes and ethnicity for the countries bordering the Gulf of Mexico and the Caribbean Sea**. It aims at providing crucial, large-scale, digital geo-spatial data needed for humanitarian assistance/disaster relief and other development.

The research team includes PI AGS President Jerome E. Dobson, Co-PI KU Geographer Peter H. Herlihy, working with KU geography graduate students John H. Kelly, Andrew M. Hilburn, and Taylor Tappan. Importantly, we partner with indigenous federations, NGOs, and national authorities, bringing together local, regional, and national communities to produce open-source maps that will be publicly available and displayed on websites.

Our research focuses on how changes in property regimes impact indigenous populations. Significantly, our previous related property regime research on our Bowman Expedition to Mexico (2005-08) documented the end of social property and break-up of communal land ownership (see project website at <http://web.ku.edu/~mexind/index.htm>; also see publications Smith et al. 2009; Kelly et al. 2010).

The Borderlands project uses open-access, public information together with field, archival, and GIS research, through collaborative agreements and participatory research mapping, to develop a comprehensive understanding of the significant changes that have occurred to property regimes in the countries bordering the United States to the south.

**Research and Results.** We outline four areas of substantive results.



### 1. Digital Maps of Honduran Mosquitia.

Collaborating with the indigenous federations MASTA and FITH, we are producing a multi-scale GIS and database for making large-scale maps and a website to display and analyze the property regimes of the Honduran Mosquitia. Our maps are being used by MASTA and Honduran authorities in their land titling of the Río Plátano Biosphere Reserve. We are also developing maps for the management plan of the Tawahka Asangni Biosphere Reserve.

Our map results for the Honduran Mosquitia that we continue to develop through our Minerva Grant have been posted on our project's website ([www.prmapping.res.ku.edu](http://www.prmapping.res.ku.edu); the site is not yet public, but has demonstrated its utility by the President of MASTA having recently posted it on his publicly accessible private Facebook site). Our research illuminates changing property regimes, here and elsewhere in the Borderlands Region, where

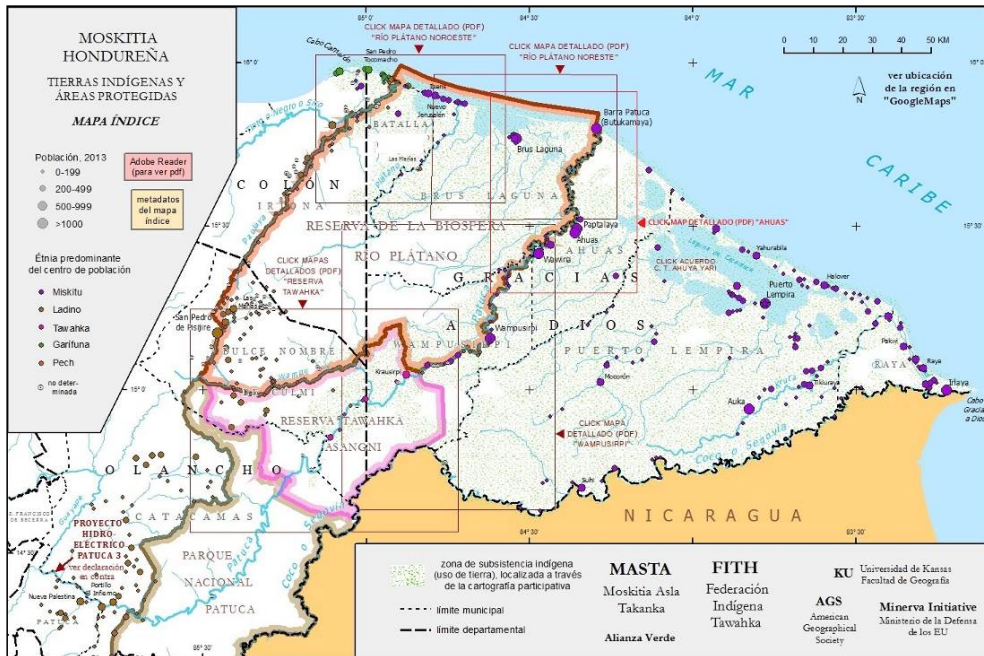
agricultural colonization frontiers collide with important forest resources and conservation areas that are inhabited by indigenous, Afro-descendant, and *campesino* populations.

Developing the GIS and database using ArcGIS 9.3 and ArcGIS 10 software, we have made dozens of "shapefiles" with thematic attributes from a variety of original sources to produce detailed, large-scale digital land use-land cover maps.

Our Mosquitia results includes the digital maps of five distinct zones: 1) Tawahka Asangni Biosphere Reserve; 2) North Coast; 3) Brus Lagoon Zone of the UNESCO Río Plátano Biosphere Reserve, covering the area from Batalla-Sico to the Río Plátano, including the Las Marias area, eastward to the Río Patuca; and we are presently working to complete the remaining areas of the Cultural Zone of the Río Plátano Biosphere Reserve, including the 4) Wampusirpi Zone, and the 5) Ahuas Zone.

We are also collaborating with the Honduran indigenous federation FITH (Federación Indígena Tawahka de Honduras), the conservation organization Alianza Verde, and the Honduran government agency, Instituto Nacional de Conservación Forestal, Áreas Protegidas y Vida Silvestre (ICF) to produce the maps for the new management plan for the Tawahka Asangni Biosphere Reserve in the Honduran Mosquitia (eight maps included in report results). We have transferred parts

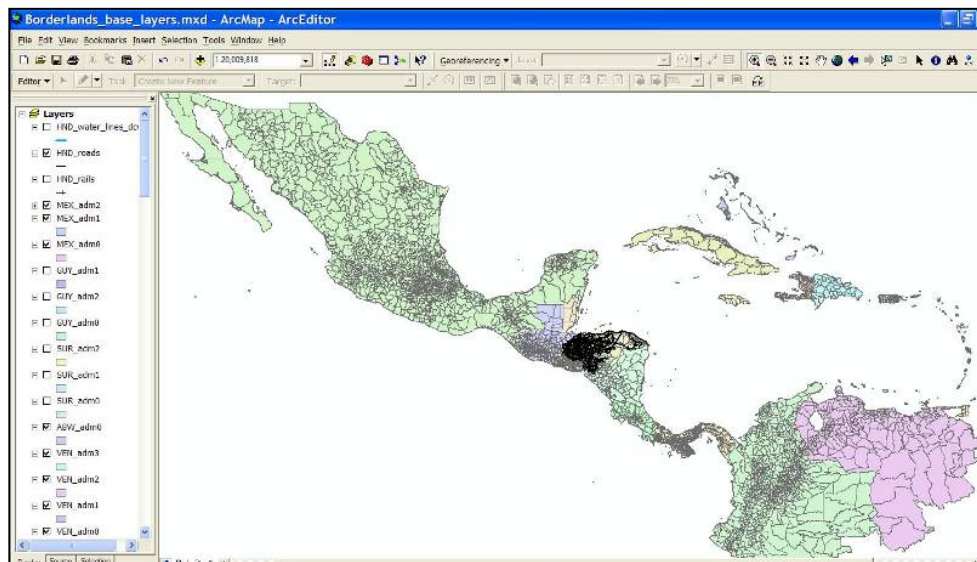
of our research results for use and applications to indigenous federations and national government agencies in Honduras through giving them digital maps, and we are in the process of transferring the GIS files related to them. The new digital maps are presently being used in the official work on the land legalization process of the Cultural Zone in the Platano Biosphere. We are presently following up a request from ICF to provide them with copies of our project's shapefiles and metadata from the Tawahka Management Plan maps for their archives on the reserve.



**Website Display.** We are collaborating with the Honduran indigenous federations MASTA and FITH to post these maps along with other geo-spatial and property regime information on their own websites on the Honduran Mosquitia region.

Our research results are **probably the most complete large-scale (i.e., highly detailed) digital mapping of indigenous lands anywhere in the world.** The GIS database and resulting maps make possible an unparalleled analysis of indigenous-*campesino* land uses and important property regime and development issues of inhabited tropical rainforest environments and conservation areas, where indigenous populations are

currently seeking and establishing autonomously governed, collectively owned properties called *Consejos Territoriales* (territorial councils).



### Borderlands Regional Platform.

More broadly, we began the development of a regional GIS platform for the U.S. Borderlands displaying essential property regime and ethnicity data for Mexico, Central America, Colombia, Venezuela, and the Caribbean states. As illustrated at left, we completed our base layers for the GIS database with state-level and county-level area shapefiles, plus natural protected areas for 30 countries, including some ancillary base files for many countries (roads, populated places, ecosystems, etc.). We also began acquiring sets of tabular data to join to these base layers for mapping

and analysis of ethnic data.

**World Human Geography Conference.** The Borderlands Research Team organized and hosted the inaugural "World Human Geography Conference: Communities and Ethics" to consider challenges in foreign place-based research. On September 15 and 16, 2011, the AGS, KU, and Haskell Indian Nations University hosted the event that focuses on specific themes of importance to government, society, and the discipline of geography. Representatives of many disciplines and communities concerned with peoples and places were invited.





*Top Left:* World Human Geography Conference participants and attendees listen to speakers in Haskell Indian Nations University Auditorium.

*Top Right:* W. Chris King, Dean at US Army Command and General Staff College speaks on the Army's need to understand culture.

*Bottom Left:* Haskell's Academic Dean Daniel Wildcat addresses the WHGC "Talking Circle" discussing ethic concerns of working with indigenous populations.

*Bottom Right:* Lee Schwartz, Geographer of the United States at the U. S. Department of State, speaks on the need for human geography in world affairs.

The WHGC Conference emphasized "communities and ethics," as well as geographic knowledge about places. We also established a WHGC website to display information about what we hope will become

an annual event.

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### **III. Translation and Cultural Adaptation of an Arabic Version of the Community Tool Box**

Stephen Fawcett, Ph.D. (Co-I)  
University of Kansas

The aim of this project was to translate and culturally adapt the Community Tool Box online resource for Arabic, thereby enhancing access to free skills-building information on community development for the Middle East and North African (MENA) Region. The Community Tool Box is a website that people in underdeveloped and war-torn regions can go to for guidance and ideas on how to build a civil society, and it supports leadership development and efforts to foster the development of civil societies.

Partners at the American University of Beirut and the Arab Resource Collective completed Arabic translation, subsequent review and editing, and cultural adaptation of priority materials, and also researched and developed write-ups of regional case studies for the Middle East and North Africa. A dissemination plan has been developed and planning is underway for a dissemination conference in November 2013 hosted by partners at the American University of Beirut. This project made

it possible for the Arabic Community Tool Box to become available online for access by those engaged in the work of civil society development in the MENA Region.

### **Organizational Development**

Colleagues at the University of Kansas provided project management and support for staff of the Arab Resource Collective (ARC) and American University of Beirut for the duration of the project.

### **Case Studies Development**

The AUB team led efforts to oversee adaptation of content and research and develop examples that reflect the Arabic culture/Middle East region; this includes adaptation for issues (e.g., Millennium Development Goals) and context (e.g., urban environments, rural villages, informal settlements) of the region. AUB and ARC colleagues disseminated a letter to NGOs in the region introducing the Community Tool Box project and soliciting potential case studies that could be highlighted as regional examples of community development. They worked with partners locally and regionally to create regional case studies in the areas of creating and maintaining coalitions and memberships, building leadership, developing an intervention, increasing participation and membership, and advocating for change.

### **Translation and Cultural Adaptation**

Arab Resource Collective colleagues worked on the translation, revision and editing of Community Tool Box material. 135 skills-building sections and all sixteen toolkits on the Community Tool Box were translated and culturally adapted, along with numerous examples (totaling 1,140,433 words): ninety percent of high-priority material for translation.

Cultural adaptation of the sections included editing names of persons and locales to reflect the context of the Middle East North African (MENA) Region. For example, where the English version refers to minorities (e.g., Afro-Americans, Latinos), ARC colleagues edited for minorities from the region (e.g., Kurds, Somali refugees) to make the text more relevant for readers. All cases modified were flagged for discussion before finalization and publication online. Similarly, text examples of priority issues (e.g., teen pregnancy, underage drinking) were edited to reflect more prevalent issues in the MENA Region.

ARC colleagues also worked to identify Arabic references (especially those available online) that could be added to the relevant sections. Such additions will help enrich the Community Tool Box and make the translated material even more credible and close to home.

### **Dissemination**

The team created a dissemination plan to promote the widespread use of the freely available capacity-building materials among those engaged in community development work in the MENA Region. A dissemination conference, to be hosted by partners at the American University of Beirut, is scheduled for November 22-24, 2013.

## **IV. Development and Implementation of an Executive Leadership Program for the Army's School for Command Preparation**

Keith Chauvin, Ph.D. (Co-I)  
University of Kansas

This course was delivered successfully and received outstanding evaluations from the commander-participants and the staff of the Army's School for Command Preparation at Fort Leavenworth. The School of Business was subsequently awarded a contract to deliver the course between August 2010 and July 2011, and another contract for August 2011 thru July 2014. The current contract gave the Army an option to renew funding for the second year (2012-13) and the third year (2013-14). The Army exercised both of these options and the contract is fully funded through August 2014, with funding approved for the first year of the contract and the Army having the option to renew the contract without an RFP for the second and third years. As of August 2013, 41 one-week sessions of the program have been delivered and virtually all brigade commanders currently in command have completed this course.

## **V. Expansion of the Supply Chain Logistics M.A. Program**

Keith Chauvin, Ph.D. (Co-I)  
University of Kansas

The plan for this thrust was to use these funds to cover a portion of the faculty costs of delivering the program and help bridge the cost of a new research faculty member in Supply Chain Management and Logistics. We had a failed search in AY10, but hired a new research faculty member, Mazhar Arikan, from Purdue University in AY11. Arikan's current area of focus is in the operational risk in service systems. His general area of research focuses on Operations Management, Logistics and Transportation Systems Management. Arikan will support both the supply chain/logistics research agenda of the School as well as the Supply Chain program.

Grant funds were used during FY12 and FY13 to cover salary and benefits for Arikan.

Grant funds were also used to cover a portion of the salary and benefits of Greg Freix, Director of the SCM-Ft. Leavenworth Program, as well as the cost of delivering one section of the program.

The program completed its fifth year in May 2013. Enrollments grew from 11 students in the 1st year to over 30 each of the last three years, and over 30 students are enrolled for the 2013-14 academic year. (See Appendix for list of graduates.) The program is highly successful. In AY10 and AY11, the Command and General Staff College and the Combined Arms Support Command (CASCOC) at Ft. Lee, used the SCM program as the core for a *Warrior Logistician Program*. The *Warrior Logistician Program* is a competitive program for select logistician officers. The Program incorporates the ILE and SCM programs with an industry experience where the participants work on business projects onsite in area businesses. CGSC and CASCOC jointly funded full scholarships for between one-third and one-half of the students in the SCM program as *Warrior Logisticians*. Ten of these scholarships were funded in AY13. While successful, the funding for these scholarships was eliminated for AY14 due to sequestration.

## **VI. Expansion of the M.A. in Global and International Studies/Interagency Studies Track Program**

Marsha Haufler, Ph.D. (Co-I)  
University of Kansas

### **Introduction**

The College of Liberal Arts and Sciences (CLAS) used this award to support the expansion of the enrollment of U.S. Army Special Forces officers in a newly created KU Master of Arts in Special Studies/Interagency Studies and added two new faculty members, a specialist in Middle Eastern history and one in public administration. Both positions were successfully added. Dr. Chris Silva was hired in School of Public Affairs and Administration and Marie Brown in the Department of History (specializing in the Middle East). Grant funds covered the first two years of their salaries, which are now entirely paid by the College. Their courses and mentoring continue to significantly enrich the educational experience provided by the ISP.

### **Background**

The Global Interagency Studies Master's degree was created by request from the John F. Kennedy Special Warfare Center and School (SWCS) at Fort Bragg, NC. The degree program was created to increase the ability of Special Forces officers to work with and in agencies of government such as the Department of State, Department of Agriculture, Department of Education, Department of Homeland Security, USAID, DEA, FBI, and with NGOs.

Funding was needed to enable smaller departments with that ability to sustain the program and increase student enrollment in it.

### **Description of the degree and course curriculum**

The Global Interagency Studies track of the M.A. in Global and International Studies program is fully funded by the United States Special Operations Command and is specifically tailored for Special Operations Forces officers.

The program began in AY 2009-10, and the first cohort of students earned M.A. degrees in Special Studies. Students now earn an M.A. Global and International Studies with a concentration in Global Interagency Studies.

The curriculum consists of 33 credit hours, with KU granting six hours of credit for ILE education. The remaining 27 credit hours come from nine KU courses that taught at two locations: night courses at the Command and General Staff College and day courses at KU's main campus in Lawrence, Kansas. The night-school classes - four courses taken in sequence - are taught from August to March at CGSC. The final five courses are taught at KU from April through July. The program is fully integrated into the ILE year to minimize the impact on officers' time.

The program is now in its third year and has 20 students enrolled, all nominated by the U.S. Army Command and General Staff College and admitted to KU through the Center for Global and International Studies.

### **Project Outcomes**

Enrollments and student achievements:

The first cohort of 16 students graduated in July 2010 with an MA in Special Studies. 7 achieved a 3.5 to 4.0 GPA.

The second cohort of 20 students graduated in July 2011 with an MA in Global and International Studies with a concentration in Global Interagency Studies. 17 achieved a 3.5 to 4.0 GPA

The third cohort of 22 students graduated in July 2012 with an MA in Global and International Studies with a concentration in Global Interagency Studies. Nine graduated with Honors, achieving a 3.5 to 4.0 GPA.

The fourth cohort of 19 students graduated in July 2013 with an MA in Global and International Studies with a concentration in Global Interagency Studies. Eight graduated with "High Pass" level, comprehensively, on their final exams (written and oral).

Faculty hires:

Dr. Chris Silvia, whose areas of specialization are public administration, public management, and public policy analysis, was hired as an assistant professor and began teaching in the School of Public Affairs and Administration in fall 2010.

Graduate courses taught:

Fall 2010, PUAD 836: Intro to Quantitative Methods;

Fall 2011, PUAD 332: Quantitative Methods for Public Administration- Undergraduate Core;

Spring 2011, PUAD 839: Topics in Public Administration: Interagency Collaboration – MPA Elective/Global & International Studies Core;

Fall 2012, PUAD 692: Research Experience in Public Administration- Undergraduate Elective;

Fall 2012, PUAD 836: Introduction to Quantitative Methods- MPA Core;

Spring 2013, PUAD 839 Topics in Public Admin: Service Management

Dr. Afshin Marashi, an expert on contemporary Iranian and Middle Eastern history, was hired as an Associate Professor of History, and taught during the 2010-11 academic year. Unfortunately, Dr. Marashi left to take a professorship at the University of Oklahoma. The History Department immediately moved to replace him, and hired Dr. Marie Brown, who began teaching in Fall 2012. A no-cost extension was requested to cover the salary of this new hire during the next academic year, 2012-13. Dr. Brown completed her doctorate in modern Middle Eastern history, with a research focus on the Sudan, at the University of Pennsylvania.

Undergraduate and Graduate courses taught:

Fall 2012/13, HIST 328, The Modern Middle East;

Spring 2013, HIST 327, The Premodern Middle East

### **Summary:**

With the backing of the College and the University, funding from the Army Research Office helped facilitate the creation of the Interagency Studies program within the Center for Global and International Studies, with seeded tenure-track faculty



positions, a faculty director, associate director, and office staff, as well as office space and operating expenses. The program now boasts a substantial curriculum encompassing Political Science, History, Public Administration, Business and Law, to the benefit of our government and Armed Forces.

## **VII. Global Security Studies Fellowships for the Foreign Military Studies Office**

Maria Omelicheva, Ph.D. (Co-I)  
University of Kansas

### **I. Introduction and background**

KU offers over 40 languages and area studies instruction in 4 world regions (Africa, East Asia, Latin America, and Russian and Eurasian spheres), as well as global and international studies. Most of the area studies program and language instruction, especially in the least commonly taught languages (LCTL) are offered through KU area studies (AS) centers, such as the Center for Russian, Eastern European, and Eurasian Studies (CREES), Center for Latin American Studies (LAS), Center for East Asian Studies (CEAS), Kansas African Studies Center (KASC), and Center for Global International Studies (CGIS).

The mission of the area studies centers and CGIS is:

- 1) To prepare specialists in regions of the world critical to US interests with advanced-level foreign language and broad significant knowledge of area cultures and societies. These specialists go on to careers primarily in government, business, law, and education; and
- 2) To serve as a source of reliable information, some of it cutting-edge research, to Kansas, the Great Plains, and national public constituencies: teachers and students, the public, business, and the military.

The US military leadership currently recognizes that much is gained through blue terrain approaches to solving world security problems, which means having significant proficiency in target foreign languages and knowledge of critical cultures. This new recognition opens an opportunity for CREES and CGIS, as well as other participating KU area studies centers, to expand training and research efforts in poorly understood parts of the world in partnership with the US Army.

### **II. Concept and Use of the Army Research Office (ARO) Grant**

To capitalize on the US Army interest in collaboration with the academic institutions and long-established ties of KU with Ft. Leavenworth, and CREES with the Foreign Military Studies Office (FMSO) at Ft. Leavenworth, CREES and CGIS put forth an idea of research assistantships to further the careers of graduate students with the language skills and research interests in security topics, broadly understood.

ARO Grant funds are used to further an educational initiative that allows KU graduate students in International Studies, Russian, East European, and Eurasian Studies (REES) and other areas to conduct and disseminate security-relevant research concerning understudied regions of the world in partnership with the FMSO. For two consecutive years, the grant supported, on average, four nine-month research assistantships per semester (8 assistantship per academic year with 4 GRAs funded through CGIS and 4 – through CREES) and three summer assistantships each 3 months long. Through this program, graduate research assistants (GRAs) receive an opportunity to pursue their research for an MA capstone paper or a PhD thesis, work together or alongside the FMSO analysts, enhance their research skills, and improve career prospects. FMSO receives extra research support staff with specialist knowledge in the language, culture and history of understudied regions, and capable of writing publishable papers on foreign countries and regions designated by FMSO's leadership, using sources in the target languages of the region. GRAs participate in a yearly conference on security-related topics important to the US Army, KU, and relevant regions of the world organized by CREES, CGIS, and other KU area studies centers jointly with FMSO. GRAs' research outcomes are also disseminated through public lectures, conference talks, and on-line and other publications.

### **III. Outcomes for FED 66525: "Global Security Studies Fellowships for the Foreign Military Studies Office" (AY 2010-2012)**

The funds of ARO#1 grant were primarily used for two major initiatives: (1) FMSO-CREES-CGIS research assistantships; and (2) Annual FMSO-CREES-CGIS security conferences. During the funding period, CREES and CGIS were able to offer a total of 16 graduate research assistantships (GRAs), including 12 semester-long research assistantships, and 4 summer research assistantships. The semester-long assistantships included a semester stipend of \$7,500, paid bi-weekly; tuition and fees at an in-state rate for a full-time graduate load (6-12 credit hours). The summer assistantship paid a stipend of \$5,000 in five bi-weekly payments and tuition and fees at an in-state rate for a graduate load of 6 credit hours. The summer assistantships could be used for field research overseas. At least two MA REES students used their summer GRAs for this purpose.

To identify candidates for FMSO research assistantship, CREES and CGIS issue widely publicized calls for applications with a November deadline for the following Spring and Summer assistantship, and a March deadline for the Fall assistantship (see Appendix I and II elaborating the full requirements for applying for and winning the FMSO-CREES research assistantship).

Much of the student research involved use of open-access foreign language sources with the goal of deepening understanding of non-English-language views. A joint scholarly output of the funded GRAs included 13 papers (4 monographs, 3 research papers, 4 special essays, and 2 book reviews). At the end of their research assistantship, each CREES research assistant gave a public lecture on the results of her/his research at one of the CREES brown bags. In addition, the students delivered 5 conference presentations.

All of the CREES GRAs made valuable contributions to the CREES-FMSO blog site: <http://crees-fmsoblogspot.com/> and submitted materials for the monthly Operational Environment Watch (OEW) <http://fmsol.eavenworth.army.mil/products.html#GSW>. The OEW was highlighted as one of the most popular new foreign news digests in the Army last year. The research assistantships have furthered the careers of graduate students with the language skills and research interests in security topics, broadly understood. Three REES MA students were accepted into the PhD programs.

**Table 1:** Summary of the Project's Outcomes

<b>Project's Outputs</b>	<b>Counts</b>	<b>Notes</b>
Papers	13	4 monographs, 3 research papers, 4 special essays, 2 book review
Presentations	14	5 conference presentations 9 CREES Brown bags
Honors and Awards	2	MA with honors
MA students funded	9	
PhD students funded	1	
MA Degrees Awarded	9	
Number who achieved a 3.5 to 4.0 GPA	10	
MA Graduates who continued into a PhD Program	3	
Conferences funded	4	
Speakers funded	25	9 keynote speakers fully funded and 16 other speakers partly funded
Administrative support	1	

**Table 2:** GRAships Funded through the Project

	<b>CGIS</b>	<b>CREES</b>	<b>Total</b>
<b>Fall 2010</b>	2 (Jeffrey Boss and Jeffrey Stocker)		2
<b>Spring 2011</b>	2 (Jeffrey Boss and Randy Masten)	2 (Nathan Pickett, Ruoxi Du)	4
<b>Summer 2011</b>	-	2 (Ruoxi Du, Patrick	2

		Callen)	
<b>Fall 2011</b>	1 (Margarita Karnysheva)	2 (Ruoxi Du, Sandra King-Savic)	3
<b>Spring 2012</b>	2 (Ruoxi Du Molly Martin)	1 (Sandra King-Savic)	3
<b>Summer 2012</b>	-	2 (Sandra King-Savic, Gloria Funcheon)	3
<b>Total</b>	7	9	16

(2) ARO#1 funds were used to sponsor, in part, four security/security-related conferences:

- August 2011 Conference on “Identity and Community After the Cold War Era” (Appendix III). The planned output for this conference is a multi-authored book, “New Approaches to Area Studies in the 21<sup>st</sup> Century.” Co-edited by Edith Clowes (KU, CREES Director) and Shelly Jarrett Bromberg (Miami University (OH), Latin American Studies), this book will be strongly interdisciplinary and will focus on understanding changing concepts of identity and community in the new century. They have already secured a preliminary contract from Northern Illinois University Press. This publication will require a \$4000 subsidy. The volume’s manuscript is currently under review.
- April 2011 Conference on “Migrations, Shadow Economies, and Security Issues on the World’s Borders” (Appendix IV)
- April 2012 Conference, “Afghanistan 2014: Impacts on Global Security Identities” (Appendix V)

The conference flyers and programs are available in the APPENDIX.

ARO#1 funds were used to fully fund 9 keynote speakers for these conferences (travel, hotel, and honoraria) and partly fund 16 other speakers. Some funds were used for other expenses associated with the events (e.g., catering, etc.).

## APPENDIX

### Appendix I.3.2: Lexicon: selected terms related to kariz systems

Term	Where term is used	Definition	Citation
karez	northern Iraq	Kurdish word, also means “working in one line”	Lightfoot, 2009
kahrez	Persia		Lightfoot, 2009
bir al-umm	northern Iraq	mother well	Lightfoot, 2009
neqba	northern Iraq	shafts to karez	Lightfoot, 2009
lagham	northern Iraq, around Erbil	the horizontal tunnel (Kurdish word meaning underground tunnel)	Lightfoot, 2009
loyin	northern Iraq, around Erbil	tunnel between two shafts	Lightfoot, 2009
kuna kotor	northern Iraq, around Erbil	“(Kurdish kun = hall and kotor = a type of bird that goes into karez channels for water; i.e. “hall of the kotor bird”)”	Lightfoot, 2009
kala bir	Iraqi Kurdistan	Source well or mother well (translated: “big well”)	Lightfoot, 2009
bira gumana	Iraqi Kurdistan	“checking well”. The well where you check to see if there is enough water to dig a karez.	Lightfoot, 2009
tayan	Iraq	First section of the karez, near the mother well	Lightfoot, 2009
manjal	Iraq	Last well before the exit	Lightfoot, 2009
killil	Iraq	karez exit point (translated as “key” in Kurdish)	Lightfoot, 2009
miftah	Iraq	karez exit point (translated as “key” in Arabic)	Lightfoot, 2009
zari karez	Iraq	Karez exit point (translated as “mouth of the karez” in Kurdish)	Lightfoot, 2009
astelik	Iraq	basin or cistern at the end of the karez	Lightfoot, 2009
wasta	Iraq	specialist who builds or maintains the karez (also the name for any expert or professional). Derived	Lightfoot, 2009

		from the Avesta word (Avesta—a 2500 year old language pre-dating widespread use of Persian in the area) “ostad” (carat over the “a”), which means professional.	
kariz	Western Afghanistan	Persian term for qanat of Iran	McLachlan, 1989
jui (singular), juis (plural)	Western Afghanistan	“water channels led on the contour, from small bunds or weirs set into the river”	McLachlan, 1989
mambo	Japan	similar to the karez (see the reference for a second chapter by different author on mambos)	McLachlan, 1989
sarchah	Afghanistan	Mother well	Rout, 2008
chah	Afghanistan	Access wells to karez	Rout, 2008
hawz	Afghanistan	Temporary water storage [basin] for karez-discharged water (overnight or to increase flow distribution rates)	Rout, 2008
karekan	Afghanistan	Specialist who is responsible for subsurface construction and maintenance	Rout, 2008
mirab	Afghanistan	Overseer of surface water distribution operations (water allocations)	Rout, 2008
arhad	Afghanistan	Shallow hand-dug well with water produced from animal power	Rout, 2008
qanat	Iran	Similar to karez	Rout, 2008
falaj	Oman	Similar to karez	Rout, 2008
foggaras	North Africa	Similar to karez	Rout, 2008
jar or chow	Afghanistan	A tiled karez-like structure, built adjacent to or into washes. It is excavated like a canal, protected with dry stone walls and slabs; difficult to maintain, frequently damaged by flooding.	Rout, 2008
jarib	Afghanistan	Land area, 5 jarib per hectare	Rout, 2008



owkura	Afghanistan	Outflow point or access point of karez water	Rout, 2008
shura	Afghanistan	Village council that elects the mirab	Rout, 2008
karezkan	Afghanistan	Specialized group of artisans who construct and maintain karezes	Favre and Kamal, 2004, part III.
qanat	Iran	Similar to karez	Hussain et al., 2008
karez	Afghanistan		Hussain et al., 2008
karez	Pakistan		Hussain et al., 2008
kahn	Baloch	Balochistan (aka Baluchistan), annexed by Pakistan in 1948. The people continue to fight for their independence.	Hussain et al., 2008
ain	Saudi Arabia	Similar to karez	Hussain et al., 2008
felaj/aflaj	United Arab Emirates	Similar to karez (singular/plural)	Hussain et al., 2008
felaj/aflaj	Oman	Similar to karez (singular/plural)	Hussain et al., 2008
kanerjing	China	Similar to karez	Hussain et al., 2008
qanat romani	Jordan	Similar to karez	Hussain et al., 2008
qanat romani	Syria	Similar to karez	Hussain et al., 2008
khattara	Morocco	Similar to karez	Hussain et al., 2008
Mother well	Baluchistan (Pakistan)	A well of karez, yielding water	Khalown et al., 1988
lamboor	Baluchistan (Pakistan)	Local name for karez tunnel	Khalown et al., 1988
Abu-Masar	Baluchistan (Pakistan)	Water manager	Khalown et al., 1988
Malik	Baluchistan (Pakistan)	Designation of head of a tribe or sub-tribe in Pashtoon areas	Khalown et al., 1988
Sardar	Baluchistan (Pakistan)	Designation of head of tribe or sub-tribe in Baluch areas	Khalown et al., 1988
Sardoar	Baluchistan (Pakistan)	The first turn of water among the karez share	Khalown et al., 1988

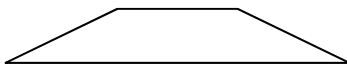
		holders	
Mirab bashi	Afghanistan (northern)	Water master for irrigation scheme, presumably appointed by the community, like Mirab	Milner et al., 2005
Mirab	Afghanistan (northern)	Sub-water master, appointed by the community	Milner et al., 2005
Vakil	Afghanistan (northern)	Leader of the traditional village committees, or shura	Milner et al., 2005
galeria	Spain	Similar to karez	
foggara/fughara	North Africa	French translation of "qanat"	

### Appendix 3.2: Kariz Dimensions in Afghanistan and Other Countries.

<b>Dimension category</b>	<b>Measurement</b>	<b>Source of information</b>
Gradient	1:1000 to 1:1500	Ahmad, 2010
	1:500 to 1:1500	Amin et al., 1983
	Less than the topography	Banks and Soldal, 2002
Length	Can extend for several kms	Rout, 2008
	Can be several km long, branched	Banks and Soldal, 2002
	Iran: up to 50 km	Beaumont, 1971; 1989
	Iran: 36% of 2000 measured were between 0.5 and 2 km long	Beaumont, 1971; 1989
	Iran: 81% of 2000 measured were <5 km long	Beaumont, 1971; 1989
Sarchah or mother well depth	30 m	Ahmad, 2010
	Up to 20 m	Banks and Soldal, 2002
	Iran: deepest mother well, 280 m	Beaumont, 1971
	Iran: mother well varies by region, but modal depth is 10-20 m	Beaumont, 1971

	Iraq: 3 m to 45 m; most are 7-12 m; mode is 10 m	Lightfoot, 2009
Tunnel dimensions	Iran: 1 m <sup>2</sup> diameter	assumed dimension, Beaumont, 1971
	Northern Iraq: rectangular, round-arch ceiling, pointed-arch ceilings; height range 0.6 m to 3 m; width range 0.5 to 2 m; average 1.5 m by 80 m.	Lightfoot, 2009
Chahs (access shafts)	20-30 m apart	Banks and Soldal, 2002
	Northern Iraq: 0.7 – 0.9 m wide, 20-30 m apart (can be <10 or >100 m apart)	Lightfoot, 2009

#### Calculation of Excavated Sediment in Chah Spoil Pile (Mound)

What	Dimensions	Sediment volume
<i>Karez excavated sediment:</i>		
Straight cylinder sarchah or chah (mother well or access shaft):	1 m diameter, 30 m deep	23.6 m <sup>3</sup>
Straight cylinder, one karez segment	1 m diameter, 20 m spacing (one-half the spacing upgradient plus one-half the distance downgradient)	15.7 m <sup>3</sup>
Total volume of sediment excavated to spoil pile around sarchah or chah	Sarchah or chah plus tunnel segment	39.3 m <sup>3</sup>
<i>Possible dimensions of spoil pile (mound), with shape of frustrum of right regular pyramid or cone, and center hole</i>		
Height:	1.2 m	
Radius of base:	4.5 m	
Radius of top:	1.75 m	
Diameter of hole:	1 m	

	Sediment volume for spoil pile dimensions:	<b>39.2 m<sup>3</sup></b>
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### **Appendix 3.3: List of Computer Simulations Modeling a Kariz Completed**

1. Test kariz  $K_h$  and ratio of kariz  $K_h$  to aquifer  $K_h$  effect on kariz flow rate: 115 simulations
2. Test the effect of the gradient of the water table on flow rate in kariz: 4 simulations
3. Test the effect of the depth of the aquifer domain on the flow rate in kariz: 6 simulations
4. Test the effect of different dimensions of kariz and depth of the aquifer domain on the flow rate in the kariz: 5 simulations
5. Test the effect of domain size on flow in the kariz: 6 simulations
6. Compare MODFLOW output with simplified model in Excel: 1 simulation
7. Test the effect of imposing fixed head at the downstream end of the model that is all one elevation against one that simulates head decrease on either side of the kariz (as if the kariz is losing water and elevating the water table downstream of the kariz): 2 simulations
8. Test the effect of shallow (water table) wells at different distances from the karez: 7 simulations
9. Test the effect of shallow (water table) wells at different distances from the karez that are pumping at different rates: 3 simulations
10. Test the effect of reducing the aquifer domain hydraulic conductivity on the shallow well setup in # 8: 3 simulations
11. Test the effect of deep wells (250 m to 280 m below the kariz) on flow rate in the kariz: 4 simulations
12. Perform initial test of inducing aquifer recharge by adding a dam on a river near the kariz: 3 simulations
13. Test different rates of regional recharge to attempt to supply enough water to the kariz to match median kariz discharge rates: 26 simulations
14. Repeat test #13 using different constant head boundaries on the domain: 18 simulations
15. Reposition the kariz in the domain to be farther from the downstream boundary: 1 simulation
16. Repeat recharge simulations on kariz positioned as in #15: 3 simulations
17. Expand the size of the domain so it is much larger than the kariz and expand the grid to reduce computation time: 21 simulation
18. Repeat recharge tests on various larger domain model: 53 simulations
19. Vary the water table gradient to determine the length of the karez in contact with the water table: 7 simulations
20. Put a pumping well at the end of the kariz, to simulate the water being removed from the aquifer, as a kariz discharges to the land surface: 3 simulations
21. Use the drain module to simulate removal of water from the aquifer, to imitate the kariz discharge to the land surface: 2 simulations.

## **APPENDIX VI.**

### **V & VI. Master's Degrees Awarded**

*Global and International  
Studies/Interagency Studies  
Track Program:*

(2010-2011 AY)

#### **NAME**

Maj. Albert A. Augustine  
Maj. Danford W. Bryant II  
Maj. Cody P. Button  
Maj. Janette L. Kautzman  
Maj. Chad J. Witherell  
Maj. David M. Hudson  
Maj. Eric V. Kreitz  
Maj. Michael A. Stone  
Maj. Edward C. Cooney  
Maj. Jeffrey P. DiMarzio  
Maj. Jarret Mathews  
Maj. Travis W. Mills  
Maj. Michael L. Mince  
Maj. Michael G. Reber  
Maj. Jose E.R. Menendez  
Maj. Nathan E. Swindler  
Maj. Mike Pearce  
LCDR Jack Riggins  
Mr. Mat Wright  
Ms. Elena Asban

*Supply Chain Management &  
Logistics Program:*

#### **NAME**

Maj. Christian Anderson  
Maj. Eric Anderson  
Maj. Marc Austin  
Lt. Cmdr. Kerry Baker  
Maj. Misca Cartwright  
Maj. Christopher Chapman  
Maj. Scott Evelyn  
Maj. James Gallagher  
Maj. Annette Garrett  
Maj. Matthew Gomez  
Maj. Jason Hanifin  
Maj. Malcom Haynes  
Maj. Anglea James



Maj. Travis James  
Maj. Nicholas Johnson  
Maj. Stephen Johnson  
Maj. Gregory Kienzle  
Maj. Matthew Knorr  
Mr. Anthony Lang  
Maj. Keirya Langkamp  
Maj. Eloy Martinez  
Maj. Ambrose Mbonu  
Maj. Patrick McClelland  
Maj. Zachary Miller  
Maj. Chad Nangle  
Maj. Dennis Ortiz  
Maj. Frederic Rodriguez  
Maj. Christine Roney  
Maj. Roy Speaks  
Lt. Cmdr. Joel Straus  
Maj. Jason Work  
Lt. Angela Watson

(2011-2012 AY)

*Global and International  
Studies/Interagency Studies  
Track Program:*

NAME

Maj. Albert A. Augustine  
Maj. Danford W. Bryant II  
Maj. Cody P. Button  
Maj. Janette L. Kautzman  
Maj. Chad J. Witherell  
Maj. David M. Hudson  
Maj. Eric V. Kreitz  
Maj. Michael A. Stone  
Maj. Edward C. Cooney  
Maj. Jeffrey P. DiMarzio  
Maj. Jarret Mathews  
Maj. Travis W. Mills  
Maj. Michael L. Mince  
Maj. Michael G. Reber  
Maj. Jose E.R. Menendez  
Maj. Nathan E. Swindler  
Maj. Mike Pearce  
LCDR Jack Riggins  
Mr. Mat Wright  
Ms. Elena Asban

*Supply Chain Management &  
Logistics Program:*

NAME

Maj. Christian Anderson  
Maj. Eric Anderson  
Maj. Marc Austin  
Lt. Cmdr. Kerry Baker  
Maj. Misca Cartwright  
Maj. Christopher Chapman  
Maj. Scott Evelyn  
Maj. James Gallagher  
Maj. Annette Garrett  
Maj. Matthew Gomez  
Maj. Jason Hanifin  
Maj. Malcom Haynes  
Maj. Anglea James  
Maj. Travis James  
Maj. Nicholas Johnson  
Maj. Stephen Johnson  
Maj. Gregory Kienzle  
Maj. Matthew Knorr  
Mr. Anthony Lang  
Maj. Keirya Langkamp  
Maj. Eloy Martinez  
Maj. Ambrose Mbonu  
Maj. Patrick McClelland  
Maj. Zachary Miller  
Maj. Chad Nangle  
Maj. Dennis Ortiz  
Maj. Frederic Rodriguez  
Maj. Christine Roney  
Maj. Roy Speaks  
Lt. Cmdr. Joel Straus  
Maj. Jason Work  
Lt. Angela Watson

*Global and International  
Studies/Interagency Studies  
Track Program:*

(2012-2103 AY)

Major Peter Atkinson, Special Forces  
Major Winn Blanton, Civil Affairs  
Major Michael Cochran, Psyop  
Major Jason Cockman, Special Forces  
Major Thomas Craig, Special Forces  
Major Dustin Dew, Psyop  
Major Russ Forkin, Special Forces  
Major Shawn Harkins, Special Forces  
Major Christian Hoffman, Psyop

Major Matthew Hofmeister, Special Forces  
Major Clement Lochner, Special Forces  
Lt.Cdr. Peter Logan, SEAL  
Major Michael Lueckeman, Special Forces  
Major Patrick McCarthy, Psyop  
Major Duane Mosier, Special Forces  
Major Ben Shumaker, Special Forces  
Mr. Jeff Staugler, NGA  
Major Arthur Veress, Special Forces  
Major William Walker, Psyop

*Supply Chain Management & Logistics Program:*

Daniel Azzone  
Beth Cook  
John Cullen  
James Everett  
James Fisher  
Robert Gambrell  
Christopher Garvin  
James Geishaker  
Derek Hoffman  
Christina Lewis  
Ernesto Lopez  
Matthew Lovell  
Justin McGovern  
Christopher McLean  
Scott McLendon  
Samuel Miller  
Brian Mize  
Gamble Monney  
Michael Mullerheim  
George Nix  
Andrew Nottberg  
Chi Park  
Jeffrey Quail  
Justin Redfern  
Chad Roberts  
Rizaldo Salvador  
Scott Savoie  
Daniel Squyres  
Matthew Sweeney  
Christine Takas  
Delarius Tarlton  
Jeremny Weestrand

## **APPENDIX VII.**

### **FMSO-KU CREES Research Assistantship**

## Announcement of competition

The Foreign Military Studies Office (FMSO) at Fort Leavenworth researches threat and security issues within the operational environment, using unclassified materials that reflect a foreign perspective. FMSO has a long history of producing research related to Eurasian security (Russia, Eastern Europe, Central Asia and the Caucasus). Among the users of FMSO's research products are U.S. and foreign universities and organizations, the U.S. Army Training and Doctrine Command (TRADOC), and the Combatant Commands. This internship is a cooperative project of FMSO and the KU Center for Russian, East European and Eurasian Studies. **REES students in either Humanities or Social Sciences, who are interested in gaining a better understanding of how the U.S. military analyzes the Eurasian security environment, are encouraged to apply for an internship position with the Foreign Military Studies Office (FMSO).**

In meeting and collaborating with analysts at FMSO (once per month; likely at KU), interns will be able to expand and deepen their research base and to develop analysis for publication. Besides having the opportunity to work with experienced Eurasian analysts on their research topic, students will attend special guest lectures and have their finished research product published by FMSO. This internship is a great opportunity to learn more about Eurasian security and military operational environment analysis and discover how open-source foreign language materials are used in developing informative research products.

### Specific Duties:

- Commit to 20 hours per week of research time.
- Complete brief biweekly written reports to Mr. Ray Finch (FMSO) with a copy to the director of CREES on achievements resulting from 40 hours of work.
- Conduct English and target-language research on multiple subjects in Russia and the region, to include social and cultural issues, current events, military capabilities, economic, and other issues as they relate to security and defense topics.
- Assist in maintaining a blog dedicated to unclassified research on Eurasian security issues.
- Complete two book reviews (500 words) on a topic related to the stated research question.
- Make a 30-minute presentation (either at CREES brownbag or special lecture) to describe the results of their research effort
- Complete a short report (2-5 pages) describing how this internship assisted helped/hindered in their overall research effort.

Semester research assistants receive a \$7500 stipend and tuition plus fringe benefits. Summer research assistants will receive a \$5000 stipend plus fringe benefits.

A full application is due November 30, 2010 for spring 2011 or March 31, 2011 for summer and fall 2011 assistantships. A full application includes the following:

- an up-to-date curriculum vitae
- written evidence of advanced-level skill in reading one of the REES area languages (this can be the results of a test or a letter from a professor who will attest to the student's advanced-level reading skills)
- a 500-word description of a relevant research question (developed perhaps for the MA capstone seminar or other seminar), making clear its relevance to security issues, broadly understood
- graduate transcripts (an unofficial copy is allowable)
- a 500-word statement expressing how this internship relates to the student's academic and professional goals.

Send application materials to Professor Edith Clowes, Director, Center for Russian, East European, and Eurasian Studies. ([eclowes@ku.edu](mailto:eclowes@ku.edu)).

For more information on the internship and FMSO, please contact Prof. Clowes, Prof. Mariya Omelicheva ([omeliche@ku.edu](mailto:omeliche@ku.edu)), or Mr. Ray Finch ([rayfin3@ku.edu](mailto:rayfin3@ku.edu)) 785-843-7806.

The screening committee for the FMSO-CREES is composed of two REES professors and two representatives from FMSO. All evaluate applicants, and all must agree that the candidates are appropriately prepared to conduct research at this level.



## **APPENDIX VII. II**

1. KU CGIS - FMSO Research Assistantship  
Announcement of competition  
28 January, 2011

FMSO-KU Global Security Studies Fellowship Spring 2011

Students interested in gaining a better understanding of the global security environment and how the U.S. military determines the environment in which it operates both during peacetime and periods of conflict are encouraged to apply for a fellowship position with the Foreign Military Studies Office (FMSO) at Fort Leavenworth. FMSO researches a broad range of global security issues using unclassified sources and materials that reflect a non-U.S. perspective. FMSO's research products are unclassified and used by U.S. and foreign universities and organizations, the U.S. Army Training and Doctrine Command (TRADOC) and the Combatant Commands, and the Intelligence Community. This fellowship is a cooperative project of FMSO and the KU Center for Global and International Studies (CGIS).

While all proposals will be considered, FMSO is particularly interested in topics that are understudied. In the past topics that have been selected included: the expansion of Hezbollah into Latin America; hydrocarbons and security in Kazakhstan; Russian reaction to the proposed deployment of a U.S. missile defense in Eastern Europe.

For the 2011 Spring Semester, FMSO would especially welcome at least one research project that examines recent scientific or technological advances associated with the innovative use of existing 'low tech' products and processes. Such a project might also address the problem of developments and applications in technology elsewhere that are neither constrained nor fostered by the rules and regulations that govern technological development in the U.S. and in other major world powers, especially in the OECD countries. While the absence of regulation can produce innovation, it may also come at a significant human and environmental cost. Such development may produce specific or unspecified benefits; we encourage applications that also explore the potential costs and security implications of unregulated or loosely regulated processes of innovation.

In meeting and collaborating with analysts at FMSO (once per month; likely at KU), select students will be able to expand and deepen their research base and analytical skills. Besides having the opportunity to work with experienced TRADOC G-2 (Intelligence) Operational Environment analysts on their research topic, students will also have the opportunity to attend special guest lectures and have FMSO assistance in promoting and potentially publishing the product. This fellowship is a great opportunity to learn more about global security and military operational environment analysis, and discover how open source foreign language materials are used in developing solid research products.

Each selected fellow will receive approximately \$9,164.00 (\$3864 for 12 hours tuition, \$5000 for a scholarship, and \$300 for fringe benefits) total for the semester.

Interested students should submit a CV, graduate transcripts (unofficial copy OK), and a detailed statement (1-2 pages) expressing how this fellowship relates to their academic and professional goals. Application materials should be sent electronically by 05 February, 2011 to Professor Thomas Heilke, Director, CGIS (theilke@ku.edu).

For more information on the fellowship and FMSO, please contact Mr. Ray Finch (rayfin3@ku.edu) 785-843-7806.

2. The screening committee for the CGIS-FMSO Research Assistantship is composed of the Director of CGIS and two representatives from FMSO. All evaluate applicants, all must agree that the candidates are appropriately prepared to conduct research at this level, and all must agree that the proposed topic falls within the guidelines and needs of FMSO's research mission and the academic profile of CGIS.

## **APPENDIX VII. III**

### **Identity and Community after the Cold War Era**

Kansas Memorial Union

University of Kansas

Thursday, August 25-Saturday, August 27, 2011

#### **Program**

#### **Thursday, August 25, 2011**

8:00 Registration and Light Breakfast Fare (Alderson Auditorium)

8:30 Welcome: Edith W. Clowes, Director, Center for Russian, East  
European, and Eurasian Studies

Opening Remarks:

Bernadette Gray-Little, Chancellor, University of Kansas

Danny J. Anderson, Dean, College of Liberal Arts and Sciences

#### **9:00-10:45—Panel 1: Rethinking National Myth** (Alderson Auditorium)

Moderator: Beverly Mack, African and Afro-American Studies/KASC

Megan Greene (University of Kansas, History), "The Taiwanese State and Identity Construction"

Adrienne Harris (Baylor University, Russian), "A Saint or a Patriot? The Resurrection of a Soviet Hero and Post-Soviet Identity"

Elizabeth MacGonagle (University of Kansas, History), "History and Memory on Robben Island"

#### **11:00-12:45—Panel 2: After Empire** (Alderson Auditorium)

Moderator: Edith Clowes, Slavic/CREES

Thomas Wilhelm (Ft. Leavenworth, Foreign Military Studies Office), "The Not-So-Great-Game: Security Identity in Central Asia since Independence"

Shelley Jarrett Bromberg (Miami University, Spanish), "From Butterflies to Baseballs: Dominican Identity beyond the Cold War"

Robert Reuschlein (Lakeland College, Accounting), "Social Decay of Empire in the United States"

#### **1:00-2:00—Lunch and Keynote Speech** (Kansas Room)

Introduction, Thomas Heilke, Political Science/CGIS

Ayşe Zarakol (Washington and Lee University, Political Science), "Liminal States after the Cold War Era: The Case of Turkey in Comparative Perspective"

#### **2:15-5:00—Panel 3: National Identity and Community Regulation** (Malott Room)

Moderator: Glenn Adams, University of Kansas, Psychology

#### **Session 1: History and National Identity as Tools for Community Regulation**

Tuğçe Kurtiş, Glenn Adams, and Alexander M. Schoemann (University of Kansas, Psychology), "Silence in Representations of American History: Implications for Identity-Relevant Action"

Marisol Fournier Pereira (University of Costa Rica, Center for Research and Studies in Politics), "Security Discourses and Fear Control in Neoliberal Systems"

Ludwin E. Molina (University of Kansas, Psychology), "Contours of Patriotism: Role of Group Discrimination"

**Session 2: Constructions of National Identity: Implications for Immigration and Social Policy**

Aileen Vargas and Eduardo Bolaños (University of Costa Rica), "Costa Rica: An Ecological and Pacifistic Country? Contributions of Social Psychology to Deepen in the Analysis of National Identities"

Sahana Mukherjee, Ludwin E. Molina, and Glenn Adams (University of Kansas, Psychology), "What Does It Mean To Be a 'True' American? Constructions of National Identity and Immigration Policy"

Ignacio Dobles Oropeza (University of Costa Rica, Psychology), "Immigration, Identities and Social Policies in Costa Rica: The Experiences of Colombian and Nicaraguan Migrants"

**2:15-3:30—Panel 4: Narrating and Archiving History** (Alderson Auditorium)

Moderator: Thomas Heilke, Political Science/CGIS

Corina Apostol (Rutgers University, Art History), "The Art of Making Community--Lia Perjovschi's CAA/CAA (Contemporary Art Archive/Center for Art Analysis)"

Marsha Haufler (University of Kansas, Art History; Associate Dean, College of Liberal Arts and Sciences), "The Visual Rebranding of North Korea in the 'Military First' Era"

**3:45-5:00—Panel 5: Internet Communities** (Alderson Auditorium)

Moderator: Anita Herzfeld, Latin American Studies

Raymond Finch (University of Kansas and Ft. Leavenworth, Foreign Military Studies Office), "Civic Awareness and the Internet—Russia 2011"

Jo Ann Oravec (Business/Economics, University of Wisconsin, Whitewater), "Personal Privacy After the Cold War: Computer Passwords, Biometrics, and Other Privacy Protections in the Construction of Identity and Community"

5:00-6:30—Dinner on your own

**7:00-9:00 "My Perestroika," screening and discussion with director, Robin Hesston**

Introduction, Tamara Falicov (University of Kansas, Film Studies)

Woodruff Auditorium, Kansas Union

Open to the public

**Friday, August 26, 2011**

8:00 Registration and Light Breakfast Fare

8:30 Greeting: Thomas Heilke, Director, Center for Global and International Studies

**8:45-10:15—Panel 6: Borders, Migration, and Identity** (Alderson Auditorium)

Moderator: Christina Lux, KASC

Monica Popescu (McGill University, English), "Remembering the Border War: Cultural Memory and Community in South Africa after the Cold War"

Amanda Schlumpberger (University of Kansas, History), "'Like Landing on the Moon': African Students and Transnational Identities in the 1960s"

**10:30-12:15—Panel 7: Regional Identities** (Alderson Auditorium)

Moderator: Geraldo Sousa, English/Latin American Studies

Rebecca Blocksome (Kansas City Art Institute), "Imagining New Identities on the Borders of Central Europe"

Austin Charron (University of Kansas, Geography), "The Common Peninsula: Ethnic and Regional Identity in Post-Soviet Crimea"

Austen Thelen (University of Kansas, Geography), "The Post-Soviet North Caucasus: Factors of Contemporary Ethno-National Identity"

**12:30-1:45—Lunch on your own**

**2:00-3:15—Panel 8: Religious and Philosophical Communities** (Alderson Aud.)

Moderator: Thomas Heilke, Political Science/CGIS

Mariya Omelicheva (University of Kansas, Political Science), "The Faces of Islamic Revival in Central Asia"

Helen Hundley (Wichita State University, History), "Siberian Buddhism, Revival and Identity in the Post-Soviet Era"

**3:30-5:00—Panel 9: State, Policy, and Identity** (Alderson Auditorium)

Moderator: Melissa Birch, School of Business/Latin American Studies

Major John Ringquist (US Military Academy, West Point), Social Networks in Post-Cold War Tanzania

Aman Memon (Allama Iqbal Open University, Pakistan Studies), "Emerging Regional Equations in South Asia and Eurasia: A Sequel to Post-Cold War Scenario"

**Evening events are for conference presenters and NRC staff.**

**5:45** Spencer Museum of Art, Teaching Gallery Exhibit, "Identity and Community"

**6:15** Presentation on Jin Shan sculpture, "It Came from the Sky,"  
Kris Ercums (University of Kansas, Asian Curator)  
Spencer Museum of Art, Central Courtyard

**6:30** Dinner for conference presenters



Spencer Museum of Art, Central Courtyard

**7:30 Concert by KU Choral Ensemble, directed by Paul Tucker**

**Saturday, August 27, 2011**

8:30 Registration and Light Breakfast Fare (Alderson Auditorium)

8:45 Greeting: Megan Greene, Director, Center for East Asian Studies

**9:00-11:45—Panel 10: Free Speech, Human Rights, and Community**  
(Alderson Auditorium)

Moderator: Thomas Heilke, Political Science/CGIS

Aleksander Bjelčević (University of Ljubljana, Slovene Literature Faculty of Arts), "Literary Fiction and Ethics: the Cases of Defamation in Fiction and Child Pornography"

Patrick Callen (University of Kansas, Russian, East European, and Eurasian Studies), "Chto delat'? Voinal!: Street Art and Censorship in Post-Soviet Russia"

Marika Janzen (University of Kansas, Peace and Conflict Studies), "Solidarity, Human Rights and the Poetics of Connection: Articulating Community in Bertolt Brecht's 'Mother Courage and her Children' and Lynn Nottage's 'Ruined'"

Elena Rodina (University of Oregon, Russian and East European Studies), "How Publication Type, Experience and Ownership Affect Self-Censorship Among Moscow Newspaper Journalists"

**12:00-1:30—Lunch and Keynote Speech** (Kansas Room)

Introduction, Edith Clowes, Slavic/CREES

Reuel Hanks (Oklahoma State University, Political Science), "*Oltin Meros* and the Territorialization of Memory in Uzbek National Identity"

**1:45-3:30—Panel 11: Rural, Urban, and Suburban Communities** (Alderson Auditorium)

Moderator: Megan Greene, History/CEAS

John Kennedy and Shi Yaojiang (University of Kansas and Northwest University, Xian, China), "Urbanization with Chinese Characteristics"

Nadia Shapkina (Kansas State University, Sociology, Anthropology, and Social Work), "Ethnic Village in Post-Communist Saratov: Building Multicultural Identities and Living Hyperreality"

Sarah Willenbrink (University of Kansas, Slavic Languages and Literatures), "Życie na poziomie (The Classy Life): Galerianki and Youth Consumerism in Poland"

**4:00-5:00—Roundtable discussion and further plans** (Alderson Auditorium)

Moderators: KU area and international studies directors

Conference Organizers:

Center for Russian, East European, and Eurasian Studies

Center for East Asian Studies

Center for Global and International Studies  
Kansas African Studies Center  
Center of Latin American Studies

Conference Sponsors:  
University of Kansas Office of the Chancellor  
Office of the Provost  
College of Liberal Arts and Sciences  
Department of Film  
Department of Slavic Languages and Literatures  
Dole Institute of Politics  
Hall Center for the Humanities  
Spencer Museum of Art  
School of Music  
US Army Research Laboratories  
US Dept. of Education, Title VI

## APPENDIX VII.IV

### April 1, 2011, Conference Program

“Migrations, Shadow Economies, and Security Issues on the World’s Borders”

Friday, April 1, 2011  
Kansas Union, Malott Room  
University of Kansas  
Lawrence, KS

### PROGRAM

8:00—Registration, light breakfast

8:20—Welcome, Edith W. Clowes, Director, CREES

### 8:30-10:00—Panel I: Migration and Border Economies in Historical Perspective

Moderator: Megan Greene (History, University of Kansas)

Margarita Karnysheva (History, University of Kansas), “The Buriats across the Borders: Smuggling and Insurgency in Transbaikalia (1921-1929)”

Ms. Margarita Karnysheva was born in Ulan-Ude, a Transbaikalian Raion station and the capital of Republic of Buriatia. In 1988 she graduated from the University of Saint-Petersburg where she majored in modern History of Japan (Soviet-Japanese Relations). Following graduation she returned to Ulan-Ude, where she worked as a translator, a hotel manager and a tour guide. In 1998 she taught History of East Asia, History of Japan and Basic Japanese Language. Then, in 2003-4 she participated in the Junior Faculty Development Program and was placed at the University of Kansas. In 2006 she started the PhD Program in the KU History Department. Her dissertation project is on anti-Soviet insurgency movement in Transbaikalia in 1920-30s.

Carlos Gomez Florentin (History, SUNY Stony Brook), “Contested Borders: The Transnationalization of the “Triple Frontera” 1940-1984”

Carlos Gomez Florentin is a Ph.D. student of Latin American History at Stony Brook University. BA in Political Science (2006) from the Universidad Católica de Asuncion, Paraguay. In 2009 earned a MA in Politics from New York University where he studied with a Fulbright Scholarship. His latest book “El Paraguay de la Postguerra: 1870-1900” was published by El Lector Press in Asuncion in 2010. Currently is working in a biography of Higinio Morinigo. His dissertation deals with the hydropolitics of the Itaipu Dam (owned by Brazilian and Paraguayan governments) and the transformation of the Paraguayan Eastern Region and the neighboring Brazilian regions.

Roger Kangas (Near-East South-Asia Center for Strategic Studies, National Defense University), “Cross-Border Security Challenges in the Fergana Valley: Views from Tashkent, Bishkek, and Dushanbe.”

Dr. Roger Kangas is a Professor at the Near East South Asia Center for Strategic Studies, located at National Defense University, Washington, DC. He previously served as the Professor of Central Asian Studies at the George C. Marshall Center for European Security in Garmisch-Partenkirchen, Germany and as the Deputy Director of the Central Asian Institute, Johns Hopkins University SAIS. He has also worked at the Open Media Research Institute (OMRI) in Prague, Czech Republic, and the Department of Political Science at the University of Mississippi. Dr. Kangas received his B.S.F.S. in Comparative Politics from the Edmund A. Walsh School of Foreign Service, Georgetown University and his Ph.D. in Political Science from

Indiana University. Dr. Kangas is a specialist on Central Asian security and politics, with a particular interest in cross-border threats and energy security.

### **10:30-12:00—Panel II: Migration, Borders, and State Responses**

Moderator: Tanya Golash-Boza (Sociology, American Studies, University of Kansas)

Jeffrey Boss (CGIS-FMSO Research Fellow, Ft. Leavenworth), “The Future of the Frontier Crimes Regulation and Implications for Security at the Afghan-Pakistan Border”

Jeff Boss is a University of Kansas: Center of Global and International Studies (CGIS) graduate student, and a CGIS/Foreign Military Studies Office (FMSO) fellow. Jeff’s research focuses on the Federally Administered Tribal Areas (FATA) in western Pakistan. Specifically, Jeff is researching the Frontier Crimes Regulation (FCR), its relationship to local norms, and potential implications of its repeal. Jeff is a Lieutenant/ Paramedic with Johnson County Med Act where is a member multiple Special Operations Group (SOG) teams and is the leader of the Emergency Operations Team (EOT).

Jeff managed the Global Crisis Response program at Heart to Heart International (HHI). During his time with HHI, Jeff coordinated multiple humanitarian responses to domestic and international emergencies.

Kornely Kakachia (Harriman Institute, Columbia University), “Cross-Border Conflict Dynamics and Security Challenges in Georgia”

Dr. Kornely Kakachia is an Associate Professor of Political Science at Ivan Yavakishvili University in Tbilisi where he teaches classes on World Politics, International organizations, and Global Governance. His research interest includes Georgian Domestic and Foreign Policy, Russian-Georgian and US-Georgian Relations, Wider Black Sea Security issues, Party systems and Georgian party Politics. In 2009-2010 he was a visiting fellow at Black Sea Security program, Kennedy School of Government, Harvard University. He worked as an analyst for the office of Special Representative of the UN Secretary-General for Georgia at United Nations Observer Mission in Georgia. He served as a President of the Georgian Young Political Scientists’ Association and received IREX Contemporary Issues/ Carnegie and Faculty Development Program Fellowship from the Open Society Institute, New York. He is active member of the International Studies Association. His recent publications include: “Challenges to South Caucasus Regional Security in the Aftermath of Russian-Georgian Conflict: Hegemonic Stability or New Partnership?”, *The Journal of Eurasian Studies* 2 (2011) and “Mixed Record of Democratic Governance in Georgia: Accomplishments, Encounters and Beyond,” published through the Vienna Diplomatic Academy, 2011.

Shannon O’Lear (Geography, University of Kansas), “Borders in the South Caucasus: Meaning and Power”

Dr. Shannon O’Lear is an Associate Professor at the University of Kansas with appointments in the Department of Geography and the Environmental Studies Program. She is affiliated with the KU Center for Russian, East European and Eurasian Studies. Dr. O’Lear received her B.A. and MA degrees from the University of Colorado at Boulder and the Ph.D. in Geography from Syracuse University. She teaches courses on Environmental Policy, Environmental Geopolitics, Geopolitics of Russia & Eurasia, Geography of Genocide, and Introductory Human Geography. Her region of research is the South Caucasus. She was funded by the National Science Foundation to conduct a study investigating resource-related conflict in Azerbaijan. She is a Board member on an Armenian Partnership Project with the Kansas National Guard, and she regularly gives briefings at the Air Force Special Operations Command Center at Hurlburt Field,

Florida. She recently completed a book titled *Environmental Politics: Scale and Power* with Cambridge University Press.

**12:00-1:30—Catered lunch**

Martha Brill Olcott (Carnegie Endowment for International Peace), “State and Security in Central Asia”

Introduced by Edith W. Clowes, Director, CREES

Dr. Martha Brill Olcott is Senior Associate at the Carnegie Endowment for International Peace in Washington, DC. Until 2001 she was a professor of political science at Colgate University. She holds the BA from SUNY Buffalo; MA and PhD from U. Chicago in political science. She is one of the leading specialists on Central Asian societies and economic and political institutions in the United States today. Her research support comes from some very impressive organizations, including the MacArthur Foundation, the Rockefeller Foundation, the Pew Charitable Trusts, the Open Society Institute... and the list goes on. Her publications include 11 books, from her first pathbreaking *The Kazakhs* (1987) to her most recent books, *Central Asia's Second Chance* (2005) and *Kazakhstan: Unfulfilled Promise?* (2010). She has written almost 120 articles, including her most recent “Central Asia's Oil and gas Reserves: To Whom Do They Matter?” in 2010. She is a frequently gives expert testimony before the US Congress on security and cooperation issues, most recently in Kyrgyzstan and has been a consultant for the US Departments of State and Defense, OSCE, various oil and mineral companies. She appears on a regular basis on public television and CNN.

**1:30-3:00—Panel III: Migration and Shadow Economies**

Moderator: Mariya Omelicheva (Political Science, University of Kansas)

Ray Finch (FMSO, Ft. Leavenworth), “Viktor Bout and Illegal Weapons Sales”

Mr. Ray Finch is a Eurasian Military Analyst for the Foreign Military Studies Office at Fort Leavenworth, Kansas. Prior to this he worked as the Assistant to the Director for the Center for Russian, East European and Eurasian Studies (CREES), at the University of Kansas. Finch is a former Eurasian Foreign Area Officer for the US Army who served in Germany, Korea, Russia, and CONUS. Upon retiring from the military, he spent a year as the Director of Corporate Security for Kroll Associates in Moscow. He has produced a number of analytical studies dealing with the Russian military and society. He is currently working on a PhD in Modern Russian History at the University of Kansas.

Ebenezer Obadare (Sociology, University of Kansas), “Paper Truths and Ersatz Lives: Authenticity and Fakeness in the West African Shadow Economy”

Dr. Ebenezer Obadare is Assistant Professor of Sociology at the University of Kansas, Lawrence, USA. He earned his Ph.D. in Social Policy from the London School of Economics and Political Science in 2005. Dr. Obadare has received many prestigious awards for his research, including the MacArthur Foundation Research and Writing grant. His articles have appeared in leading peer-reviewed Africanist journals, including *African Affairs*, *The Journal of Modern African Studies*, *Politique Africaine*, *Africa Development*, and *Review of African Political Economy*. In 2008, Dr. Obadare was honored as the year's Virginia and Derrick Sherman Emerging Scholar by the Department of History at the University of North Carolina, Wilmington. He is the author of *Africa Between the Old and the New : The Strange Persistence of the Postcolonial State* (UNCW, 2008) and co-editor of *Encountering the Nigerian State* (Palgrave, 2010).



Nadia Shapkina (Sociology, Kansas State University), “Survival and Gendered Risks of Migration in Central Asia: Shifting Sex Trafficking Flows in the Asian Heartland”

Dr. Nadia Shapkina is an assistant professor of sociology at Kansas State University. She a native of Russia who graduate from Saratov State Technical University (Russia), received her MA in Sociology from Central European University (Poland), and completed her Ph.D. studies in Sociology at Georgia State University (Atlanta, USA). Dr. Shapkina studies global commodity chains as applied to commercial sex trade industry, as well as transnational anti-trafficking organizing.

**3:00-4:30—Conclusions, Discussion, and Further Plans**

Roger Kangas (Near-East South-Asia Center for Strategic Studies, National Defense University)

**6:00—No-host dinner at Tellers (upstairs)**

This conference is sponsored by the Center for East Asian Studies, the Center for Global and International Studies, the Center of Latin American Studies, the Center for Russian, East European, and Eurasian Studies, the Kansas African Studies Center, and the Foreign Military Studies Office, Ft. Leavenworth. It is partially supported by an Army Research Offices grant and a US Dept. of Education Title VI grant.

# Afghanistan 2014

## IMPACTS ON GLOBAL SECURITY IDENTITIES



Wednesday  
25 April 2012

Malott Room  
Kansas Union  
University of Kansas

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## **Appendix VII.VI: Program for Security Conference**

8:00—Registration

8:30—Welcome: Edith Clowes (Director, CREES) and Thomas Wilhelm (Director, FMSO)

8:45-9:30—Opening keynote address: Marlene Laruelle (Political Science, George Washington U.), “Central Asia and Russia, Looking at the 2014 Withdrawal: Perceptions and Strategies”

9:30-11:00—Panel I, Afghanistan and the World: Security Identities after 2014

Ahmad Majidyar (Subject Matter Expert, Leader Development and Education for Sustained Peace [LDESP]), “An Afghanistan Perspective of Security after ISAF Withdrawal”

Ruoxi Du (CREES, U. Kansas), “Chinese Perceptions toward the Post-2014 Afghanistan”

Vadim Kozyulin (PIR Center, Program for Conventional Arms, Moscow), “Afghanistan: What to Expect, and What Does it Mean for Russia”

11:15-12:45—Panel II, Afghanistan in Central Asia: Security Identities after 2014

Matthew Stein (Foreign Military Studies Office, Ft. Leavenworth), “Uzbekistan’s Viewpoint of Security in Afghanistan after 2014”

Thomas Wilhelm (Foreign Military Studies Office, Ft. Leavenworth), “Pakistan’s Tribal Areas and Security Perspectives after Withdrawal”

Lewis B. Sckolnick (Rector Press Intelligence), “Afghanistan: The Realities of Its Security and Trade in the 21<sup>st</sup> Century”

1:00-2:00—Lunch

2:00-2:45—Graeme Herd (International Security Program, Geneva), “After Afghanistan: Implications and Emerging Paradigms after Withdrawal”

3:00-4:30—Roundtable on “Post-2014 Afghanistan: Stepping into a New Era of Security Challenges”

Mediator, Roger Kangas (Near East South Asia Center for Strategic Studies, National Defense U., Washington DC), with all conference speakers

4:30-5:00—Concluding discussion: Roger Kangas